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# Technology Review

Edited at the Massachusetts Institute of Technology

## TECHNOLOGY AND WILDLIFE

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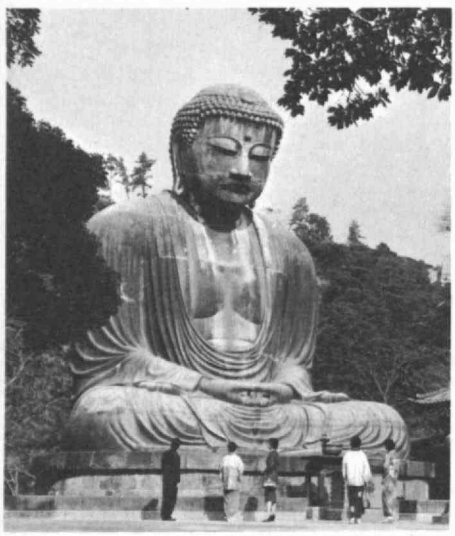

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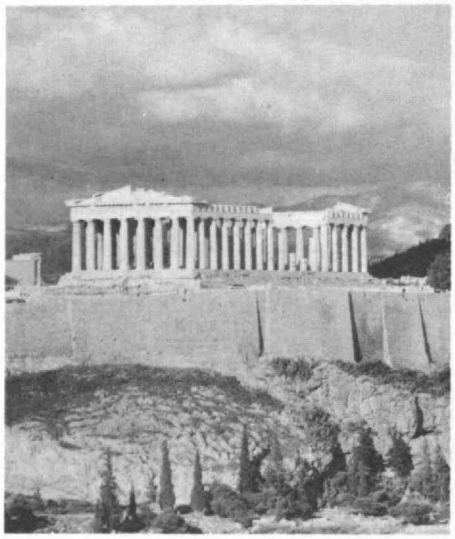

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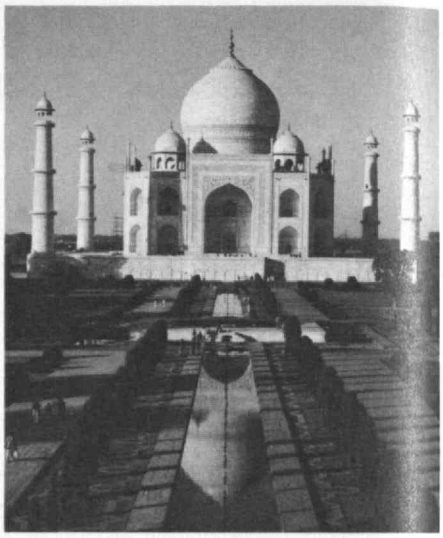

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peal s of "Volcano Alley" to visit an Indian mar et; the great viceregal city of LIMA, fou ded by Pizarro, where one can still see Piza ro's mummy and visit the dread Court of the Inquisition; the ancient city of CUZCO, high in the Andes, with an excursion to the fabu ous "lost city" of MACHU PICCHU; cos opolitan BUENOS AIRES, with its wide stre s and parks and its colorful waterfront dist ct along the River Plate; the beautiful Arg ntine LAKE DISTRICT in the lower reac es of the Andes; the spectacular IGUASSU FA LS, on the mighty Parana River; the sun- hed beaches, stunning mountains and mag ificent harbor of RIO DE JANEIRO (co idered by many the most beautiful city in the world); the ultra-modern new city of BR SILIA; and the fascination of the vast Am zon jungle, a thousand miles up river at MA AUS. Total cost is $2100 from Miami, $22 0 from New York, with special rates from oth cities. Optional pre and post tour visits to Pan ma and Venezuela are available at no addi- tio l air fare. Departures in January, February, Ap , May, July, September, October and No mber 1974.

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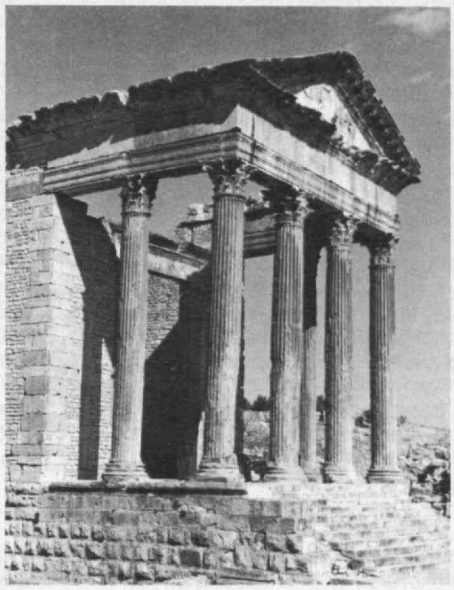

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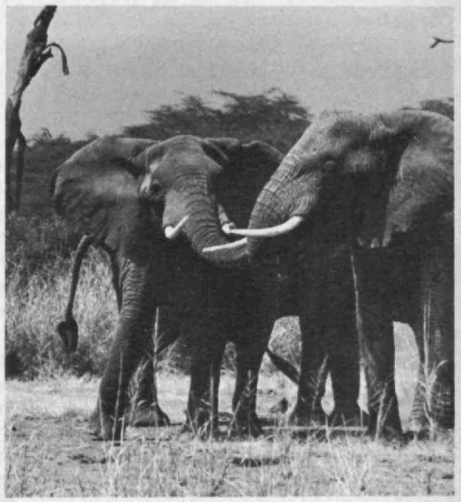

pink flamingos at LAKE NAKURU; multitudes of lion, zebra, wildebeest and other plains game in the MASAI-MARA RESERVE and the famed SERENGETI PLAINS; the great permanent concentrations of wildlife in the NGORONGORO CRATER; tree-climbing lions along the shores of LAKE MANYARA in the Rift Valley, photographing rhino and other big game against the majestic snow-covered background of Mt. Kilimanjaro in the AMBOSELI RESERVE; and the vast and fascinating wilderness of TSAVO NATIONAL PARK, renowned for its elephant and lion and for the unusual desert phenomenon of the Mzima Springs. There is also a stay in NAIROBI, the most fascinating city in East Africa, as well as features such as a visit to a MASAI MANYATTA to see tribal dancing and the tribal way of life. Total cost is $1799 from New York. Optional visits are available to the VICTORIA FALLS, to UGANDA, and to ETHIOPIA. Departures in January, February, March, May, June, July, August, September, October, November and December 1974 (extra air fare for departures in June, July and August).

* * *

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# Letters

**More Facts on Recycling Aluminum**

Some figures given by R. Stephen Berry and Hiro Makino in "Energy Thrift in Packaging and Marketing" (*February, pp. 32-43*) puzzle me: On page 36, the chart indicates 6.4 kw.h. per 12-oz. aluminum can just to prepare the aluminum for the can, with another 0.33 kw.h. to form the can; on page 40, the table gives 1.91 kw.h. as the free energy required to produce a 12-oz. aluminum pop-top can; and in the text on page 40 Professors Berry and Makino state that recycling scrap aluminum cans would save 1.7 kw.h./can. Since we are trying in our museum to show how energy and materials can be saved, I'd like an accurate figure to present to the public.

James P. Harrington
Philadelphia, Pa.

*The writer is Director of Exhibits at the Franklin Institute of Philadelphia. Professor Berry responds:*

The caption on page 36 is emabarrassingly misleading, and the figure, which neglects the remelting of scrap, is also not clear. The figure of 6.893 kw.h./can is for "all-new" aluminum—but of the 7.4 tons of aluminum melted for each ton of cans produced, most of the remaining 6.4 tons of home scrap goes back into pots, to be used. The net average cost is about 1.91 kw.h./can, not 6.893 which would only apply if the can manufacturers were foolish enough to throw out their scrap. They are not fools; they are quite clever and able people, and are certainly thrifty with scrap.

**Reactor Wastes for Irradiation and Power?**

You note (*"Trend of Affairs," March/April, p. 65*) the possible use of radioactive (cobalt-60) irradiation for purifying water. I also see articles on the problem of disposing of nuclear reactor wastes and how much heat they generate. Why is it that I don't see proposals to utilize the radiation from such by-products for sterilization and for energy production?

W. Everett Swift
Falmouth, Mass.

*The* Review *asked David J. Rose, Professor of Nuclear Engineering at M.I.T., to comment:*

It is true that very substantial decreases in both biologic activity and in the concentration of certain chemicals can be achieved by radiation from whatever source. One of the difficulties, of course, is that the elemental materials are not removed, and in general the nutrients upon which bacteria grow therefore still remain in the water. Cobalt-60 is not the radioactive material usually imagined for large applications; there are cheaper fission product materials available, as Mr. Swift suggests.

But the actual amount of heat in nuclear reactor waste is not very large. Calculations show that—except for a few special applications—radioactive reactor wastes are not useful for generating power.

**Can We Go Beyond Reactor Safety?**

"Why the Experts Can't Agree on Reactor Safety" by David F. Salisbury (*March/April, pp. 6-7*) covers an issue of vital importance which seems elsewhere to be discussed by advocates with self-serving interests. May we look forward to additional papers on those other important related areas to which this paper was not addressed—waste management, fuel reprocessing, and fuel transportation?

Edward A. Merrill
San Francisco, Calif.

**Energy in Pulp and Paper**

As R. Stephen Berry and Hiro Makino suggest (*"Energy Thrift in Packaging and Marketing," February, pp. 32-43*), it may well be time for man to concern himself with "thermodynamic thrift" in a world where resource limitations are becoming increasingly apparent. But there are several aspects of the pulp and paper industry which the authors have overlooked and others which they have presented inaccurately.

Although it is true that a given unit of paper product made from recycled fiber requires less energy than an equal unit made from primary wood fiber, in fairness it should also be said that primary fiber operations obtain a large proportion of their energy from their own process wastes such as spent pulping liquor and bark. A typical kraft linerboard mill, for example, obtains some 50 per cent of its energy requirements from these sources. Some of the newer mills obtain upwards of 75 per cent.

Recent American Paper Institute surveys show that the energy required in plants manufacturing recycled paperboard averages 19.4 million B.T.U.s per short ton, compared with an average of 29.5 million B.T.U.s per short ton for primary linerboard mills. However, since 50 per cent of the energy consumed in the primary mills was generated from process wastes, the net energy demand from purchased fuels averaged only 14.8 million B.T.U.s per short ton.

The authors would probably argue that, process wastes or not, spent pulping liquors and bark are a "free" source of energy in a world of limited energy resources and that, within this broader concept, their consumption is in no way different from that of purchased fossil fuels. But there is an important distinction between fossil fuels and wood. The former are formed over millions of years and, for human purposes, are finite; wood is a renewable resource.

The authors state that 114 million tons of paper and paper board are found in municipal wastes each year. This is an absolute impossibility since in 1973 the total amount of paper and paper board used by Americans was only slightly over 67 million tons. Of this, 14 million tons were recycled last year; 10 million tons went into permanent uses such as files, books, and building materials; and another 4 million tons were handled by municipal sewage systems and private septic tanks, home incineration, or disposal in rural areas, or were exported. Thus, simple arithmetic will show that only about 39 million tons could even potentially end up in municipal wastes.

The assumption that a ton of pulp requires two tons of waste paper is also inaccurate. As a general rule in the industry there is a 10 per cent shrinkage from waste paper to pulp. Consequently, it requires only about 2,200 lbs. of waste paper to make a ton of pulp.

Edwin A. Locke, Jr.
New York, N.Y.

*The writer is President of the American Paper Institute.—Ed.*

**From Nuclear to Geothermal**

It is saddening and frustrating to see in David F. Salisbury's report in the (*March/April, pp. 6-7*) so much splendid brain power thrown away by overlooking the real and overwhelming danger in the development of nuclear power. This danger is the impossibility of absolutely preventing theft of fissionable materials by terrorists. In view of the continual spread of terrorism, how can any responsible person possibly doubt that some group, somewhere, somehow, will succeed in stealing the materials and proceed to annihilate one or more of our greatest cities?

Please tell David Salisbury to stop wasting his ability on the subject of nuclear power plant safety and got cracking on the development of geothermal energy, which will eventually supplant all nuclear power anyhow. It's distressing to see geothermal energy skipped over lightly in all the discussions of the energy problem, when this is the one dark horse that will surely prove to be the ultimate answer. The amount of effort that went into the space program indeed, the effort that went into the atom bomb program in World War II, should easily solve the problem of bringing up the utterly inexhaustible heat already in being only 15 or 20 miles underfoot anywhere on the face of the globe, including under your office.

William B. Elmer
Andover, Mass.

**Paedantic Orthopaedics**

I found your spelling of "orthopaedic" (*see "Repairing the Human Skeleton," March/April, pp. 32-41*) disturbing, because I had to fight the impulse to pronounce the third syllable as though it were spelled with a long "i." This word, like encyclop(a)edia and p(a)ediatrics, is derived from the Greek word for child, *pais, paidos*.

Then why "ae"? The reason is that on their way to us these words passed through Latin, and the Romans, finding the diphthong "ai" uncongenial, changed it to "ae," which better represented their pronunciation. Well, our pronunciation is better served by a simple "e." Your alternative seems merely paedantic.

Arthur J. Morgan
New York, N.Y.

# To Antarctica With Love

Science-at-Large
by
Peter Gwynne

**The presence of oil and other exploitable deposits is likely, although not confirmed, in Antarctica. And seals and other food resources are plentiful, and can remain in good supply if they are "harvested" with care and ecological understanding.**

Antarctica is a frigid landmass the size of Mexico and the United States together that was not discovered until the 1820s, and not landed on until 70 years after that. In the early years of this century this southernmost continent was the scene of extraordinary acts of heroism, as small groups of dedicated explorers forged into the interior of the continent, towards the geographic and magnetic south poles, often at the cost of their lives. More recently, and particularly since the International Geophysical Year (1957-58), it has become the focal point of an ecumenical exercise in pure science, with groups from a dozen or more nations braving the frigid temperatures and gusting gales to gain basic knowledge, unobtainable elsewhere, in such fields as meteorology, atmospheric physics, glaciology and geology.

Now, the likelihood is growing that Antarctica may become useful in more immediately practical terms, as a source of oil, minerals and, probably most important, food. The extent of such resources within the icy land and its surrounding seas remains a matter for speculation at present, but the handful of scientists working on the continent are convinced that they exist in large amounts.

Such was the picture of Antarctica I obtained in a recent tour of the continent, under the auspices of the National Science Foundation, which funds U.S. research there, and the U.S. Navy, which provides transport, construction, and maintenance for much of the nation's antarctic effort.

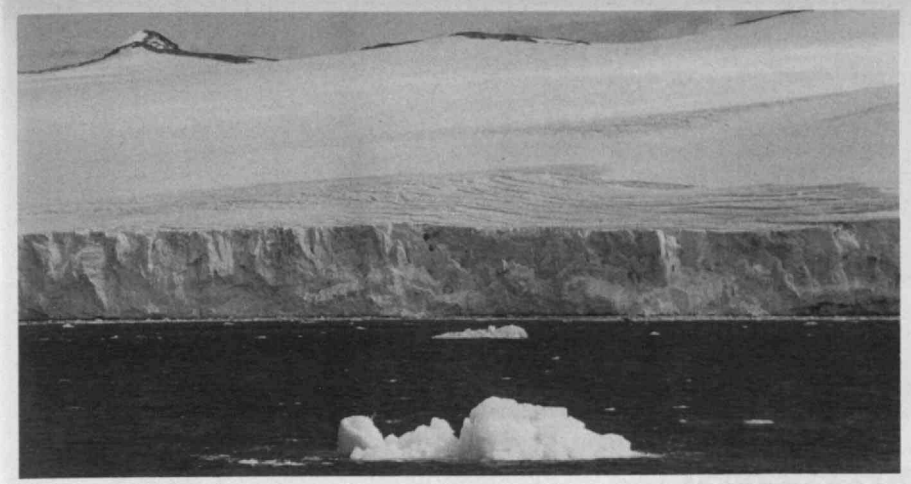
The idea of exploitation is hardly new to Antarctica. The first man to see it was almost certainly a whaler who, in the effort to get away from the competition, had strayed into extreme southerly waters. (The fear of competition from other whalers for the productive waters also kept such sightings out of the history books). Later in the nineteenth century, increasing numbers of whalers and sealers risked icy death in the incredibly productive antarctic waters, and virtually decimated many of the species of mammals they were seeking. Today, the antarctic whale population is still minimal, but the number of seals are believed to have largely recovered from that unregulated era of slaughter—so much so that many experts believe that antarctic waters can once again be tapped, with appropriate safeguards, for the food, blubber, and skins that seals so amply provide.

The seals provide an excellent example of the new approach to exploitation—or harvesting, to use the less pejorative word—in Antarctica. At present, under the terms of the 1959 Antarctic Treaty, man can only kill antarctic seals for his own survival, or to provide food for the handful of dog teams kept on the continent. (One might note that the most famous group of all antarctic survivors, Sir Ernest Snackleton's Imperial Transantarctic Expedition of 1915, which spent nine months drifting on an ice floe after its ship Endeavour was crushed by the sea ice, owed their lives to an unmitigated diet of seal and penguin meat.) Such harvesting of seals has obviously next to no effect on their numbers, and gives little indication of what full-scale harvesting might do to their population and breeding capacity. Thus, as a preliminary step before changing the treaty's provisions regarding seals is even considered seriously, a major project is under way to take a census of the seals and calculate a safe harvest.

Because of the nature of seals' activities, it is insufficient simply to take aerial surveys of the numbers of the mammals basking on each square mile for the ice; that is merely the starting point for the project, which is headed by Dr. Donald Siniff of the University of Minnesota. In order to obtain a head count of each and every seal, including the dominant males who spend as much as five days in the water before emerging to bask on the ice for any length of time, the researchers have tagged some of the 900-pound mammals with tiny radio transmitters, whose signals can be received only when they are above the ice, and have lowered underwater television cameras through holes in the ice.

With precautions such as this, the experts believe that they may eliminate the possibility of overharvesting antarctic seals, if indeed the decision is made that they can be harvested at all. In addition, the seals have behind them a huge body of public opinion apparently motivated by the captivating puppy-like faces and huge eyes of the baby seals, and ready to take to the streets when such delightful creatures appear to be in danger of harm. (The outcries against clubbing of young seals in Canada is an example of the strength of the seal lobby, for this method of killing, although apparently gory, is probably the least painful to the seals themselves.)

Other antarctic resources, however, don't have the same appeal to people. The most important are krill-shellfish which



were the basic fodder of whales when whales roamed the antarctic waters in large numbers. They may provide part of an answer to the world's food crisis. Scientists from DePaul University are starting a major study to understand the metabolism and movements of the krill; this project could eventually lead to krill harvests for the hungry.

In addition, the presence of oil and minerals has been hinted at, if not completely confirmed, by geological drilling on the continent and its continental shelf. But to date, such antarctic deposits remain undisturbed.

In this energy-short, food-short world, it will undoubtedly be just a matter of time before pressure mounts to exploit those resources sooner than the scientists would like. Already, the Atomic Energy Commission has announced its interest in possibly disposing of nuclear waste through the antarctic ice-cap, in total contravention of the antarctic treaty as it now stands, and one must doubt whether governments and corporations will be any less inclined to mention the unmentionable where food and energy resources are concerned. Plainly, the antarctic environment itself is one of the best lines of defense for the continent's resources, and equally plainly, it is possible to harvest some of the continent's resources without damage. But any effort to overexploit Antarctica in response to current shortages could spell an end to one of the most successful conservationist ventures on earth.

*Peter Gywnne, former Managing Editor of* Technology Review, *is an Associate Editor at* Newsweek.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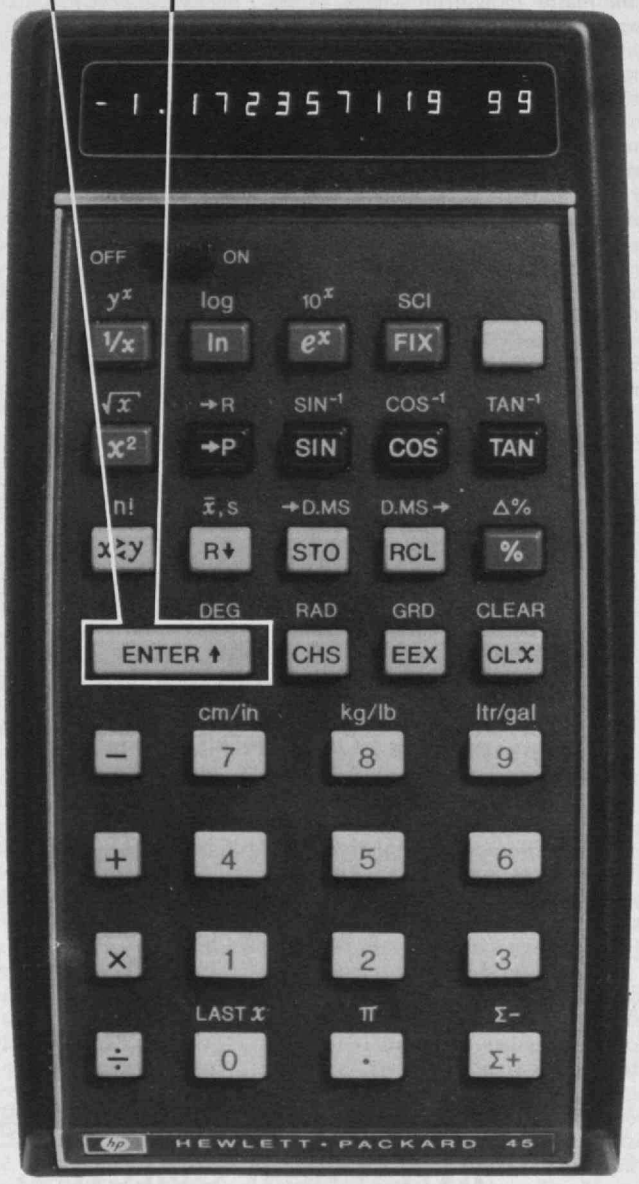
In 1928 a Polish mathematician, Dr. Jan Lukasiewicz, invented a parenthesis-free but unambiguous language. As it's evolved over the years it's come to be known as Reverse Polish Notation (RPN), and it's become a standard language of computer science.

Today, it's the only language that allows you to "speak" with total consistency to a pocket-sized calculator. And the only pocket-sized calculators that use it are Hewlett-Packard's.

ENTER↑ is the key to RPN because it enables you to load data into a 4-Register Operational Stack with the following consequences:

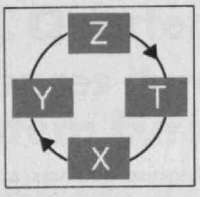
1. You can *always* enter data the same way, i.e. from left to right, the natural way to read any expression.
2. You can *always* proceed through your problem the same way. Once you've entered a number you ask: "Can I operate?" If yes, you perform the operation. If no, you press ENTER↑ and key in the next number.
3. You can see *all* intermediate data anytime, so you can check the progress of your calculations *as you go.*
4. You almost never have to re-enter intermediate answers—a real time-saver, especially when your data have eight or nine digits each.
5. You don't have to think your problem all the way through beforehand to determine the best method of approach.
6. You can easily recover from errors since each operation is performed sequentially, immediately after pressing the appropriate key, and all data stored in the calculator can be easily reviewed.
7. You can communicate with your calculator efficiently, consistently and without ambiguity. You always proceed one way, no matter what the problem.



# The HP-45 uses RPN.

That's one reason it's the most powerful pre-programmed pocket-sized scientific calculator. Here are 8 others:

**1.** It's pre-programmed to handle 44 arithmetic, trigonometric and logarithmic functions and data manipulation operations beyond the basic four (+, −, ×, ÷).

**2.** 

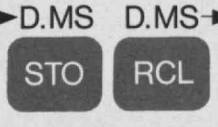
It offers a 4-Register Operational Stack that saves intermediate answers and automatically retrieves them when they are required in the calculation.

**3.** 
It lets you store up to nine separate constants in its nine Addressable Memory Registers.

**4.** It gives you a "Last X" Register for error correction or multiple operations on the same number. If you get stuck midway through a problem, you can use the "Last X" Register to unravel what you've done.

**5.** 

It displays up to 10 significant digits in either fixed-decimal or scientific notation and automatically positions the decimal point throughout its 200-decade range.

**6.** 

It converts angles from decimal degrees, radians or grads to degrees/minutes/seconds and back again.

**7.** 

It converts polar coordinates to rectangular coordinates... or vice-versa. In seconds.

**8.** 
Its Gold "Shift" Key doubles the functions of 24 keys which increases the HP-45's capability without increasing its size.

# The HP-35 uses RPN too.

If the HP-45 is the world's most powerful pre-programmed pocket-sized scientific calculator, the HP-35 is runner-up. It handles 22 functions, has a 4-Register Stack, one Addressable Memory Register and also displays up to 10 digits in either fixed-decimal or scientific notation.

*Domestic U.S.A. prices, not including applicable state and local taxes.

# New low prices.

HP-45: $325* HP-35: $225*

Now the exceptional value of these exceptional instruments is even more apparent, because we've cut their prices by $70.* You can now own the world's most powerful pocket-sized pre-programmed scientific calculator, the HP-45, for only $325.* The HP-35 now costs just $225.*

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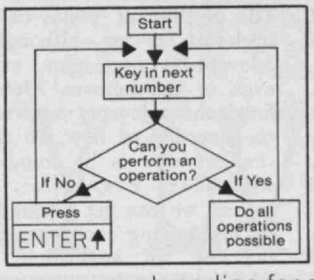

It demonstrates the superiority of Dr. Lukasiewicz' language by comparing it to other calculators' systems on a problem-by-problem basis, and it explains the algorithm shown above which lets you evaluate any expression on a calculator that uses RPN and an Operational Stack. This booklet is must reading for anyone seriously interested in owning a powerful pocket-sized calculator.

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# The Theory of Human Betterment

Economics/Sociology/Technology
by
Kenneth E. Boulding

I conducted an interesting little experiment with my freshman class this semester. In front of *The American Almanac*, which is a vast collection of statistical goodies put out by the U.S. Bureau of the Census, there are several pages of statistical indicators for the United States, about 400 in all, giving the values in 1960, 1965, 1970, 1971, and 1972. I asked each student to go through this list quickly and evaluate each item about which they had any opinion on a scale of +5 to −5 as to whether the change from 1960 to 1972 had made things better or worse for society as a whole. Plus 5, of course, would represent a stupendous improvement, −5 a disastrous worsening, and 0 neither good nor bad, or simply don't care. Then I asked each student to add up algebraically all his pluses and minuses and get some kind of average per item. I did the exercise myself and I came out with an average of about +.5, suggesting very mild improvement over the 12 years. About a third of the students thought things on the whole had got worse, about half thought things had got better, and about a sixth were neutral. On the whole it was a steady rise of standard economic indicators that probably pushed the average slightly over to the positive side.

The numerical results of the exercise are not as interesting as the theoretical questions which it raises. How do we evaluate the performance of a total society? How can we judge whether it is going "up" or "down"? The main problem of evaluative theory is how do we know which way is up? If we know that, we do not have to worry so much about where is the top of the mountain, as that may be very far off anyway. We may worry a bit about the rate at which we are going up, which can be too slow and can presumably hardly ever be too fast. In my more pessimistic moods I am quite willing to settle for direction no matter what the rate: as long as we are going up and not down I will be satisfied. This assumes, of course, that the best is yet to be, which sounds like good 19th-century optimism.

### Evaluating the Universe

The exercise brought out clearly some of the grave difficulties of general evaluation. What we are really doing is writing a function G = F (the universe), in which G stands for goodness, simply defined as an indicator which goes up when things get better and down when they get worse. The first task, of course, is to define the relevant universe as a subset of the total universe. Even this is not easy. The position of Venus in the heavens is irrelevant to me, although it might be relevant to astrologers, and on occasion even to astronomers. After we have defined the relevant universe there is still the question of how we describe it. The simplest way is by numbers. We could write $G = F(a, b, c, \ldots)$. Then, of course, we can get a rough measure of G by multiplying each element in the function by an evaluation coefficient, or "shadow price," as economists sometimes call it, as we did in the exercise. We then have $G = F(ap_a + bp_b + cp_c \ldots)$, where $p_a$, $p_b$, $p_c$, etc. are the valuation coefficients. This, of course, is much too simple, but it is at least a start.

If people put different values on the state of the universe at a given time, it may be because their estimates of the "a"s, "b"s, "c"s or their $p_a$, $p_b$, $p_c$ are different. One difficulty here is that the perceptions of the elements and the valuation coefficients are not unrelated. Our perceptions of things that have a high value to us are often more acute than those which have a low value or a negative value. We do wishful perceiving as well as wishful thinking. Another difficulty is that the elements of the function are often interrelated; when "a" goes up, "b" goes down, so that it is not easy to develop a taxonomy of the relevant universe that is significant from the point of view of evaluation.

### The "Paradox of Decision"

This came out very clearly in the exercise. Most students seemed to be delighted when wages went up, but were distressed when prices went up. We should not, therefore, do independent evaluations of elements which are related. If when "a" goes up "b" always goes down, we should try to put "a" and "b" together in some index. This is what we are doing, of course, when we construct indices of real wages or per-capita real income and things like that. Social statistics seem to be harder to deal with in this way than economic statistics. Is it, for instance, the absolute number of divorces, divorces per capita, or divorces per marriage that we want to evaluate?

Then, of course, we face the problem of the imperfect sample. Many things that are relevant to valuation are not in the statistics, either because numbers and indicators are hard to collect or because the concept itself is hard to quantify. Quantification is always dangerous if it leads to an evaluative neglect of the things that are hard to quantify. We tend to forget these and also perhaps devalue them simply because they are hard to quantify. The recent volume *Social Indicators 1973* (Washington, D.C.: U.S. Department of Health, Education and Welfare), containing such delectable items as what percent of the population is afraid to go out at night, is a beginning in quantifying the less quantifiable.

We have another problem, which I did not attempt to solve in the exercise, of assessing not merely the value of movements of particular indicators, but their importance. To some extent this is taken account of in the shadow pricing. If a rise in something, for instance, is regarded as both very important and very good, we are likely to give it a +5, whereas if it is very good but not very important we will assign it a lower number. Sometimes, however, the differences in evaluation may be due to difference in estimate of importance rather than an estimate of the value itself.

Another problem is that of cross valuations. A rise in "a" may be regarded as very good if there is a lot of "b," but bad if there is only a little "b." Thus, if "a" is the rate of increase of energy use and "b" is per-capita real income, we might regard an increase in "a" as very good if "b" is low and not good at all if "b" is high. This is an extension of the very general principle of the nonlinearity of the goodness function. I have sometimes called this the "parabola principle," because any section of the goodness function with G in the vertical axis and any element in the argument on the horizontal axis will look something like a parabola. That is, when we have a little of anything, more of it is better, but when we have too much of it, then more of it is worse. The maximum point of the parabola is, of course, the famous Aristotelian mean, which I am also tempted to call the "Goldilocks point," that is, the point at which things are "just right," like the Little Bear's porridge.

The great principle of maximizing behavior is that decisions are always what we think at the time is the best out of a set of alternative futures. Decisions, therefore, are always based on the evaluation

(*Continued on p. 63*)

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# BUCHAREST & TRANSYLVANIA

**Boston Evening Departures:**
**Departs Monday, September 30 — Returns Monday, October 7**
**Departs Monday, October 28 — Returns Monday, November 4**

*For a fraction of the ordinary airfare alone, we are going on an entire, week-long charter-flight vacation to one of the world's unique and ancient lands, a place of soaring eagles and mountain stags, of medieval palaces and Byzantine churches, where gypsy caravans still roam mountain roads and colorful villages celebrate each week's end with dancing in their public squares. Bordered by the blue of the Danube River, crested by the peaks of the famed Carpathians, this is Eastern Europe's only Latin country, its name given by the Romans, its language very nearly Italian. Here is where the poet Ovid lived (and from where his poetry was smuggled to Rome), where the legendary vampire Count Dracula ruled (in an eerie castle we can visit), where writers like Ionesco ("Le Rhinoceros") and sculptors like Brancusi still flourish. We'll visit this kingdom's five-hundred-year-old capital whose gaiety and excitement make it known world-wide as the "Paris of the Balkans." Here we can idle in enchanting open-air cafes, dance 'til dawn in a panoply of spectacular nightclubs, shop for Moldavian carpets, Dacian pottery, embroidered silks and linens in the open-air Obor Market-place (or in a myriad of boutiques), browse through any of the twenty museums, attend opera, ballet, a daily circus performance, or Europe's only Yiddish theater, and savour Romanian wines, unique fruit brandies, and Europe's most fantastic food (wait 'til you taste real Romanian pastrami!). We'll visit that fabled fairyland, the one-time kingdom called Transylvania, where, nestled in valleys amid towering mountains, lie small, gingerbread villages, arbors of plums, pears, and grapes, folk costume, festivity and handicraft, and a hospitality unique throughout the world. We are travelling to Romania, and, in so doing, we are going to a nation whose historical battle and aspiration for political independence we, as Americans, can greatly admire.*

## *Our trip is planned to include:*

* Round-trip Jet Transportation between the city of departure in the United States and Bucharest, Roma via a large, four-engine Boeing 707 jet of Tarom International Airlines, the international airline of Romania, one of Europe's oldest (est. 1921) and mos experienced carriers. Full-course meals and complimentary beverage (including Romanian wines) will be served aloft each way.

* On Arrival and Departure, Motorcoach Transportatio for Persons and Luggage between Romania's Otope International Airport and our hotel, including porterag of luggage into and out of our hotel rooms.

* A Romanian Welcome Fest on arrival, featuring a Romanian national plum brandy, tzuica drink, and Romanian wines (or tonic if we prefer). Hosted by our International Weekends, Inc. tour personnel and representatives of Carpati (the Romanian National Tourist Department), the gathering will give us the chance to make new friends and plan our activities.

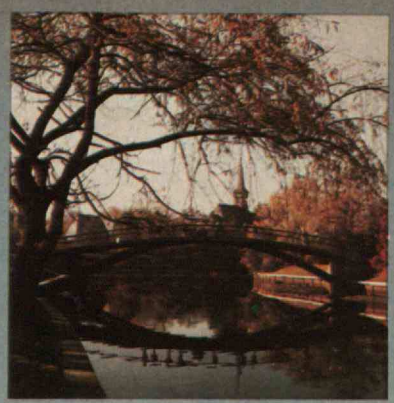
* A Romanian Breakfast Each Morning during the cour of our trip, featuring Romanian coffee prepared in the Turkish fashion, Romanian foetaj (pastries), jam, butter, tea or milk.

* First Class Hotel Accommodations for three nights in Bucharest in twin-bedded rooms with private bath or shower at the beautiful, new Parc Hotel or equivalent. Our rooms will be clean and bright, have private telephone, and be appointed with contemporary Romanian furnishings. The Parc Hotel has a large din room, an international bar, a fanciful gift boutique, newspaper kiosk, and full services including room service.

* A Romanian Folk Music and Dance Lesson Gathering has been planned especially for us, featuring horas, sirbas, and other folk music with a special group dance lesson to teach us some of the steps.

* A Half-Day Motorcoach Sightseeing Tour of Bucharest with English-speaking guide, will show us such important sights as *the 15th-century ruins of the Old Princely Court (one of Count Dracula's haunts); the State Jewish Theater (the only Yiddish Theater now performing in Europe); the Romanian Patriarchy Church; the lovely Dimbovita River; the Bucur Church (built by Bucur the Shepherd for whom the city is name the charming Manuc Inn (dating from 1808 and still in use today); the Museum of History of Romania; Liber Park and the Heroes' Memorial; the exquisite Russian Church; the Romanian Athaeneum (Bucharest's first concert hall); bustling University Square; the Opera House; Floreasca Lake; the towering Triumph Arch (commemorating Romanian unification); the Village Museum (with open-air folk art exhibits); the Hall of t Palace of the Republic; the Pioneers' Palace; the Museum of the History of Bucharest; the Central Mili Museum; Stavropoleos Church; the Palace of Justice the fascinating George Enescu Museum; the beautif Botanical Gardens; Magheru Boulevard (with its ma shops and boutiques); Cismigui Park; the open-air C Market; the Palace of the Grand National Assembly; Palace of Mogosoaia (in a lovely park setting); the qu*






*Cretulescu Church; the Bucharest Circus; the Herastrau Cultural and Rest Park; "23 August" Stadium; and more . . . . .*

A Special Romanian Fashion Show, one day will permit the group to view (and buy) the exciting dress which is unique to Romania, including fur coats, lambskin jackets, beautiful embroidered blouses, and handsome cravats.

A Special Romanian Gift Exhibition will be planned to explain the work of Romanian artisans, a chance to learn of Romania's colorful heritage.

Motorcoach Travel Between Bucharest and Our Transylvanian Hotel (and return) will take us from Bucharest's Danubian Plain, through the hilly sub-Carpathian region and the Prahova Valley, to the high regions of the Transylvanian Plateau. In our journey (approximately 2 hours in each direction), we'll follow the Prahova River, (bordered with villages of Byzantine and folk architecture, with natives clad in colorful folk fashion), past Sinaia (the resort community known as the Pearl of the Carpathian Mountains) with its Peles Castle (former residence of King Carol I ), and ascend the steep precipices of the Carpathian Mountains along the same route pursued by Turkish invaders challenging the heart of Europe in the Middle Ages. A fabulous journey we'll long remember.

A Drive Through Brasov (the town in which we will be staying) will end our journey from Bucharest. In driving through the city, we shall see ancient fortifications with their granite watchtowers, magnificent mansions encircled by protective battlements, the world-famous Black Church (set to flame by Mongolian Tartars), the Brasovian cablecar which ascends to Timpa Peak, and much more.

First Class Hotel Accommodations for three nights in the Brasov region in twin-bedded rooms with private bath or shower at the beautiful Capitol Hotel or equivalent. Again, our rooms will be clean and bright, with private telephone, and furnished in the Transylvanian fashion. The Capitol Hotel has a large dining room, an international music bar, areas for shopping, and complete services including room service.

A Concert of Classical Romanian Music will be given for us in Brasov's famous Black Church.

A Walking Tour of a Transylvanian Farm Village, such as Rasinari, will show us the peasant life of an ancient settlement where animals are led down the main street from the pasturelands on Carpathian slopes, where women repose on house-front benches weaving colorful rugs and chemises, where water is still drawn from wells (we can taste the clear spring water), and bells still chime from church belfries over quaint red-tile roofs.

* A Romanian Nightclub Banquet Dinner, one evening at the Carpathian Stag Restaurant, a 16th-century cellar. During our fantastic four-course dinner, featuring the best Romanian cooking and complete with after-dinner brandy and coffee, we shall enjoy a full show, including Romanian folk dance and song performed by the waiters and waitresses of the restaurant.

* A Romanian Wine Tasting Party for the entire group will precede the Nightclub Banquet Dinner, our chance to taste the breadth of Romanian red and white wines, known throughout the world for their "gold medal" quality.

* The Romanian Perinitza Kissing Dance will follow the banquet dinner, a chance for us to participate in Romania's world-famous dance phenomenon.

. . . . . .

* The Services of International Weekends, Inc. Tour Host Personnel will be available to the group throughout the trip, well-informed people to advise and assist us as we may require.

IE PRICE AND WHAT IT INCLUDES: The price own on the front cover of this folder includes und-trip jet transportation (on charter flights) tween the city of departure in the United States d Bucharest, Romania, transfers of persons and ggage, on arrival and departure, between the rport and our hotel, first class hotel accommoda- ns, on a double occupancy basis, for three nights Bucharest and three nights in the region of Brasov, continental breakfast each morning, motorcoach ghtseeing tour of Bucharest, round-trip motor- ach transportation between Bucharest and r hotel in the region of Brasov, one table d'hotel nner with show, a welcome get-together with manian beverage, such group activities as may, the discretion of the Travel Agent, be planned r the group, the services to the group of tour host rsonnel, and Tax and Service. The phrase "Tax d Service," as used in this folder, means and cludes only the taxes, tipping and service charges Romania. The constitution of the total price for is trip (air transportation, land arrangements, and lministration) and possible price fluctuations erefor are set forth elsewhere on the back cover this folder. The items enumerated in the first ntence of this paragraph are expressed in neral terms, because International Weekends, c. (the "Travel Agent") reserves the right, without ving to refund any monies to passengers, to ter, change, or make substitutions in the trip, itinerary, and its features provided that such terations, changes, or substitutions do not minish the aggregate fair market value of what to be included in the trip. The price of this trip es not include expenses of passports, items of a rsonal nature such as laundry, telephone, food d beverage other than specifically included, ited States and Romanian departure taxes, rrently $3.00 and $2.20 respectively (for which xes each passenger should be invoiced before parture), or any other item not specifically stated rein to be included in the price of the trip.

NGLE RESERVATIONS: The price stated on the nt cover of the brochure is per person based double occupancy of a hotel room. Single servations require an additional charge of **$69**

OCUMENTS: No visa is required for travel to manía. Each passenger is responsible for taining and having with him a valid United States assport. A certificate of smallpox vaccination sued within three (3) years preceding departure recommended but not required.

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FINAL PAYMENT AND CANCELLATION: Payment of final balance is due sixty (60) days in advance of departure (at which time reservations will be confirmed). Reservations may only be cancelled by written notice sent by registered mail (return-receipt requested) to the Travel Agent. If such notice is received by the Travel Agent no later than sixty (60) days before departure, the Travel Agent will accept the cancellation and refund all monies. If such written notice is received within sixty days before departure, the Travel Agent will accept such cancellation and refund monies only if the cancelling party finds eligible substitute(s) for the reservation(s) being cancelled. Cancellation insurance (protecting against the loss of air fare) is available and recommended.

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INSURANCE: Ordinary travel insurance is available for those who wish it.

## Optional Side Trips

Here are a few of the optional side trips available for purchase.

**COUNT DRACULA'S CASTLE**
A trip to the legendary vampire's Bran Castle, perched high in the Carpathian Mountains.

**THE BLACK SEA RIVIERA**
A full-day trip to the exquisite sunny beaches of Romania's Black Sea Coast.

**A DAY IN KIEV**
A full-day trip to the charming capital of Russia's Ukraine.

**A DAY IN ISTANBUL**
Fly to the exciting crossroads of the world for a day of sightseeing with return flight the same evening.

**"THE SISTINE OF THE EAST"**
A day trip to the fairyland world of the frescoed medieval monastery at Voronetz.

**NIGHTS ON THE TOWN**
A variety of nightclub tours to the best of Bucharest and Brasov.

**RESPONSIBILITY, ETC.:** Each person making reservation for or participating in the trip described in this folder understands and agrees to all the terms, conditions, and limitations set forth in this folder including the following: air transportation for this trip is held out and engaged the sponsoring organization whose name appears on the front cover of this folder, which organization acts as agent for the group of persons to be transported thereby. endeavoring to make arrangements with various persons, firms, and corporations for the services and accommodations described in this folder to be included in this (or in any optional side trips), International Weekends, Inc. (the "Travel Agent") acts strictly as agent for the air carrier in the case of the air transportation and as agent for the tour participants in the case of all other services. As agent, the Travel Agent shall not be responsible or liable for, AND EXPRESSLY DISCLAIMS ANY RESPONSIBILITY OR LIABILITY FOR, any loss, cost, injury, expense, or damage to person or property which results, directly or directly, from any act, whether negligent or otherwise, commission or omission (including but not limited to delay of any person, firm, or corporation which is to, shall, does provide products or services in connection with the trip, including but not limited to transportation services (whether by air, sea, or land), lodging, food and beverages, entertainment, sightseeing, luggage handling, or touring or escorting. The Travel Agent reserves the right to decline, accept, or retain, at any time and for any reason any person as a participant in the trip. If any person removed by the Travel Agent from the trip, a proportion refund for unused services will be made. The Travel Agent reserves the right to cancel the entire trip for any reason at any time before departure, in which event the liability, if any, of the Travel Agent shall be limited to and liquidated by refunding to each prospective participant the monies, if any, theretofor received by the Travel Agent for such person's trip, which monies have not been or should not otherwise refunded to him.

****The price of this trip is constituted as follows: Air transportation, $202.00 per person; land arrangements $138.85 per person; administration, $3.00 per person total price, $343.85 per person.**

**The air fare stated above is a pro rata cost to each of 177 passengers; shou/d there be fewer than 177 passengers, each passenger may, at least forty-five days before the departure date, be notified of any increased pro rata cost to him and will have the option to pay the difference or cancel without penalty.**

**The cost of the trip is based on the monetary exchange rate of U.S. Dollars to Romanian Lei as existed on January 1, 1974 and on tariffs, rates and costs in effect as of January 1, 1974; should there be between then and the date of departure, an increase in such exchange rate or such tariffs, rates or costs, each passenger may be required to pay an increased amount for the trip reflecting such increase.**

**The aircraft being utilized for the air transportation is a Boeing 707 jet with seating capacity for 177 passengers. Reservations applications will be processed strictly in order of their receipt by the Travel Agent, with a waiting list maintained for any reservations in excess of 177. All reservations applications must be mailed, in all events, before the reservations deadline set forth below.**

## THIS WAY TO ROMANIA

**TO:**
Mr. Jack Newcomb
M.I.T. — E19-238
77 Massachusetts Avenue
Cambridge, MA 02139

**MY CHECK IS MADE PAYABLE TO:**
M.I.T. Quarter Century Club

Please Check One:
Sept. 30 ____ Oct. 28 ____

**Enclosed is $ _____ ($100.00 per person) as deposit for _____ reservation(s) on the Romania trip, subject to the terms stated in this folder.**

**NAME(last)** _____ **(first)** _____

**ADDRESS** _____

**CITY** _____ **STATE** _____ **ZIP** _____

**TELEPHONE(9-5)** AREA CODE _____ NUMBER _____ **(after 5)** AREA CODE _____ NUMBER _____

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I have attached a list of names, addresses, and telephone numbers of those persons for whom I am requesting reservations, and have indicated whether single or double accommodations are required.

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# A Generalist's Manifesto for the Years to 1984

Stuart Chase

As the author of a number of books on social and economic problems, beginning with *The Tragedy of Waste*, I have been trying for many years to determine the major trends on which *homo sapiens* is riding. I have not achieved dazzling success but may have got hold of one or two dependable conclusions.

For example, I am reasonably certain that a tolerable livelihood for both high- and low-energy societies depends upon the solution of three major problems, all due to modern technology:

—The threat of thermonuclear war.

—The population explosion, resulting primarily from the control of epidemics, such as cholera, by medical science. While the birth rate does not greatly change, the death rate declines sharply. Through the gap population pours.

—The waste of natural resources and the destruction of the environment in a welter of air, water, and land pollution, much of it irreversible. Mankind must find a workable balance with its means of subsistence in nature, if civilization is to go on.

In thinking about these three primary problems—and I spend a good deal of time thinking about them—I find it convenient to shorten the titles to "Bombs, Babies, and Bulldozers." Or, if you wish, "Plutonium, Population and Pollution."

The most serious political problem, of course, is how to unite in common purpose low-energy societies—two-thirds of mankind in Asia, Africa, and Latin America—with the affluent one-third in North America, Western Europe, Russia, and Japan. No nation, no regional group of nations, can go it alone in an age of advanced technology. The current petroleum crisis is driving that lesson home.

### A Global Priority

Accordingly, I conclude that one of the priorities for constructive action in the next decade is global unity or "functionalism" made increasingly necessary by the energy crisis, expanding pollution of the oceans, the population explosion in the hungry world, skyjacking, guerilla terrorists, the world currency debacle, the wave of kidnapping. We may be moving in the right direction even now, toward a global control of oil through a world-wide cartel of producers and consumers proposed by Dr. Kissinger to allocate petroleum output. Meanwhile, the necessity for international research and development in alternative sources of energy grows ever more demanding; for ourselves and for the underdeveloped world we need to work together on solar energy, nuclear fusion, geothermal, shale, gasification of coal, and others.

The Arab petroleum blockade of this winter could be only the beginning of a world-wide phenomenon. Similar actions can be imagined by other nations rich in aluminum, tin, zinc, mercury, and other essential elements in short supply. How long will the United States, Western Europe, and Japan tolerate the blackmail of raw materials which furnish their life's blood? We are beginning to hear cries for domination through some new form of economic or even military action. But Saudi Arabia and Kuwait are reported to respond that the oil wells are mined; one aggression from the west or east and the mines will be detonated.

Will Peru, Chile, Rhodesia, and Venezuela adopt similar game plans? And where does that get *homo sapiens*? Is there any solution to this insanity except a series of world controls?

All such functional controls and allocations are closely tied to the flow of international money and credit. For example, Clyde Farnsworth, writing in the *New York Times* late in 1973, estimated that the Arabs will take in some $50 billion for sales of oil in 1974, while the most these states can possibly absorb in capital goods and consumer goods in 1974 is $10 billion. What happens to the other $40 billion? It could create a world financial crisis without precedent, and once more we encounter the grim functional imperative of one world or none!

Generalists are increasingly aware that we are entering an epoch where the management and transfer of physical goods—oil, copper, sulphur, chromium, bauxite—will take precedence over the transfer of money and the compound interest thereon, contrary to the pattern of the last 200 years. Cost benefit calculations are now more likely to run in terms of kilograms, liters, and kilowatt hours than in dollars and marks and rubles. You may come to the gas pump with $100 in crisp new bills, but if there is no gas, where are you?

Functionalism also appears in the expansion of multinational corporations. They handle enormous amounts of raw material and manufactures and yet have no firm political base from which to operate. Many are larger—as measured in G.N.P.—than most of the member states of the United Nations. From what home base shall they operate?

### Priorities for America

A generalist, while he must be wary of unilateral disarmament for the United States at this particular moment in history, sees plenty of waste—defined as output which adds nothing to the quality of life and may even depress it—in the Pentagon's defense outlay from some $90 billion a year. He would like to reduce it to perhaps $20 billion, retaining a fleet of nuclear submarines as a quite satisfactory deterrent, following the advice of Ralph Lapp and other nuclear physicists in this regard. The unemployed soldiers, sailors, technologists, and munitions workers resulting from this vast budgetary savings, the generalist believes, should go to work without loss of income on federal and state government programs in the construction of mass transit, the reconstruction of cities, the building of new towns such as Reston and Columbia, the control of air and water pollution, massive recycling operations, solid waste disposal, open space protection, restoration of lands destroyed by open-pit mining, inauguration of the metric system, and so on.

Where's the money coming from? John Kenneth Galbraith and the modern economists who follow John Maynard Keynes note that meeting depression and unemployment with publicly financed outlays results in no net loss to the economy. A society can afford anything it can produce, as we learned in World War II; and, at that time, furthermore, we were producing mostly war goods, not peace goods.

Americans must accept the principle of "slow down and live." Meet the reduction in the oil supply by using smaller cars at lower speeds, mass transit, car pools, and bicycles—and by keeping their houses at 68°F. Go easy on gas-guzzling gadgets, illuminated outdoor advertising, junk mail, night lighting for sporting events; see if you can still use your feet occasionally.

The finely modulated art of planned obsolescence in American industry, especially for motor cars, should be taxed out of existence as rapidly as possible. Useful artifacts should be made not only to sell but to last an honorable life—say 200,000 miles for an automobile, like many present taxicabs.

(*Continued on p. 63*)

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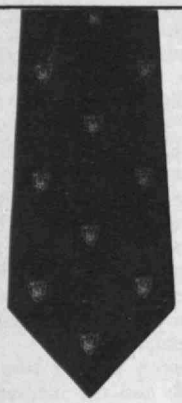


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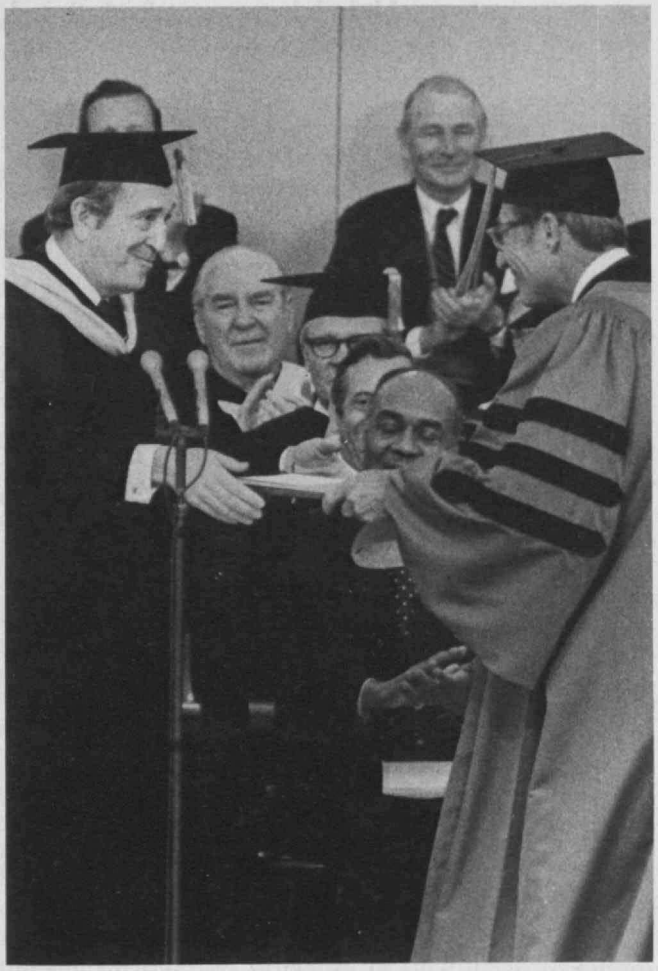
# Information and a Free Society



"In education a scientist gifted and humane; in the nation's service a counsellor wise and moderate; in Cambridge our warm friend and good neighbor."
—Citation to Jerome B. Wiesner, President of M.I.T., for the Honorary Degree of Doctor of Laws, Harvard University, June 13, 1974.

*The following is the principal text of President Wiesner's address to the members of the M.I.T. Class of 1974 at Graduation Exercises on May 31.*

Analyzing the American character as revealed by Watergate is the rage this year. But more important issues are at stake: Underlying the whole affair are deep ethical and moral matters, questions of values that we all must face.

In addition, Watergate has specifically heightened my professional concerns about the withholding and misuse of information which can powerfully affect our ability to maintain a free society. This has been a concern of mine for many many years, but today Watergate highlights the already-present dangers.

We are about to observe the 200th anniversary of the founding of our federal system. There has been considerable discussion and much disagreement about an appropriate celebration. A decade of crisis—domestic and foreign, social, economic and environmental—has driven home the dilemmas, contradictions, and challenges of contemporary life and chilled the enthusiasm for any joyous congratulatory festival. But in my view there is still much to celebrate if the celebration takes the form of a regrouping—that is, a review of our assets, accomplishments and shortcomings, and a critical, evaluative look at the present society, which is, after all, the only platform upon which we can build.

The physical resources and technical skills clearly exist to provide for our material and physical well-being. The challenge is to use them effectively. Can we learn how to manage the society better, including those aspects of it so profoundly affected by the rapid development of technology—technology which, while a boon in many respects, has outstripped for the moment our ability to cope with the changes its wide-scale use has brought about.

Our present problems, technology-induced and otherwise, are clearly part of a stream that will always exist in the continuing process through which the society is trying to learn how to better satisfy the needs and wants of us all. In doing this, it encounters, and sometimes creates, new problems which must, in turn, be solved. One of the major tasks for us as an institution and as individuals interested in the application of scientific knowledge to human welfare is to be more sensitive and more responsive to incipient troubles. In particular, our present need is to develop techniques for

The dangers of hoarding information which should properly be public are manifold, and the practice is "a primary cause of much of the erratic and convulsive tenor of our time"

detecting, understanding, and responding to problems that require collective action, and to develop the means by which our society can continually learn from its efforts. This, in significant measure, is an information problem.

**Control the Word; Control the World**

Right now we have communication and information problems which are inhibiting our ability to learn quickly enough about the effects of our collective decisions and to respond to problems that arise before they get out of hand. Such learning depends, in a free society, on the free, full, and timely flow of information to its citizens, making possible more timely, more sophisticated citizen response which can guide governmental decision-making. The Constitution of the United States intended for the ultimate power to be in the hands of the governed, but if information about the state of the nation which is vital to decisions can be withheld or manipulated, the citizens' judgments and decisions obviously can be manipulated. Perhaps it is not too facetious to say that he who controls the word controls the world.

Thus you see that Watergate is primarily about information. Stripped of the cops and robbers aspect of the pre-discovery phase, the stealthy maneuvering of its second phase or the complex legal encounters of the present phase, it has been at every instance a battle to control information which somehow was regarded by someone as vital enough to justify quite extreme measures to control it, to obtain it, or to bottle it up.

But Watergate is just a symptom of more pervasive information problems. The expanding use of data-bank and electronic intercept devices is emerging as a serious threat to individual freedom. If through technical means—electronic interception of communications or access to data accumulated in computer memories such as those in the Internal Revenue Service, the Social Security system, credit bureaus, the F.B.I., and other agencies—if by these devices information can be obtained to intimidate individuals, a powerful weapon for subversion exists.

During 1971, Senator Ervin's Constitutional Rights Subcommittee of the Senate Judiciary Committee heard testimony of widespread collection of information against anti-war organizers, speakers, and demonstrators. In these hearings, many individuals expressed concern that modern technological means had produced a subtle shift in the balance of power that the Constitution deliberately established between individual and state and were now providing the state with more power than was safe. In Watergate, those devices were on occasion used against the press, other media employees, governmental employees, and private citizens. Legislation was proposed by the Rights Committee to control and limit the use of information in data banks and other technical means of violating individual privacy. Some progress has been made in controlling the use of centralized information and limiting the use of illegal surveillance, but obviously not enough. The Bill of Rights has, to an unknown degree, been undercut by new information technology, and it must be repaired by legislation. It is sometimes hoped that new technology will undo the damage, but I believe that this is unlikely. Violations are made by humans, not by machines.

Further legislation is required to protect our freedom and rights from self-righteous government. State and federal legislation which established controls over information data banks is developing rapidly, but there is great reluctance to stop the flagrant misuse of electronic surveillance devices. Despite strict laws limiting the use of electronic surveillance, violations of the law by governmental agencies and private individuals persist. Such actions must be regarded as extremely serious and the punishment for participation or acquiescence in such acts made commensurate with the threat they pose to freedom.

**Indian-Wrestling for Information**

Beyond the misuse of personal information, lack of information caused by secrecy restrictions has been perhaps the most important single source of malfunction of our society during the past quarter century. The most dramatic examples of this are found in the foreign policy and military fields, where the electorate at large, and even the Congress, has frequently been unable to make reasonable judgments about proposed or on-going activities of the executive branch because of the unavailability of information with which to validate basic operating assumptions. When members of the public know that they are not well-informed, they will readily allow important decisions to be made by "experts"—be they military experts, research and development experts, or budgetary experts. In my opinion, the arms race would not have existed, certainly not in its extremely dangerous and costly form, if the evidence on which military decisions were made had been available

to the public or even the Congress. Governmental leaders also frequently take an action on too *little* information, making big decisions on intuition, and it would be important to know this fact too. But this is another major issue which goes beyond the scope of these remarks.

In the last few years we have witnessed a gigantic struggle between the news media and the Administration in Washington with regard to information involving a variety of events—ranging from the disclosure of the Pentagon papers, containing diplomatic and military information on the origins of the Vietnam War, to the attempt to cover up the Watergate break-in. Similar Indian-wrestling between the members of the news media, particularly the press, and governmental officials has gone on as long as there have been free societies. The ability of the media to expose governmental corruption and the "cover-up" of inadequate performance is a vital safeguard of our free society, but it is extremely risky to depend upon the accidental discovery or the clandestine leak by a concerned governmen al employee to provide the connective feedback in our society.

I would like to call into question the wisdom of the current practice which not only authorizes the withholding of a wide range of information from the general public but is based on the assumption that such withholding is in the national interest and should be the norm. In the area of technology, for example, it has become clear that the practice of withholding information concerning military technical developments and releasing it only on the very restricted basis of "need-to-know" has served primarily to slow down technical progress in the U.S. and to cast a veil of mystery over the debates about new weapon systems and disarmament issues. Technologists generally agree that the most important fact about a new bit of technology is the fact that it exists—information already made quickly available through Congressional hearings and trade magazines.

Congress passed a Freedom of Information Act in 1966 with the aim of making government information available to the people. This Act was passed despite opposition by every single federal agency. It is a badly written bill that has a vast number of exemptions and that requires a petitioner to seek court assistance if his request for information is denied. But it represents a beginning, and it must be greatly strengthened, particularly with respect to opening up governmental information sources to the public.

The U.S. must conduct most of its official business in the open. Some vital pieces of information such as contingency plans, plans for negotiations, data about individuals, details about some work in progress, intelligence information, and perhaps some other categories will have to remain private; but these should be the exceptions, and there should be a well-established process for defining them. The norm should be an open flow of information available within the government and from the government to the public.

The hoarding of properly public information is a major threat to the preservation of our free society and its unavailability is a primary cause of much of the erratic and convulsive tenor of our time. The more general release of most kinds of information will enable the societal learning system to function more smoothly. And it is protection from the misuse of personal information that will enable each of us to feel free to use the rights which we have, under our form of government, to question, to object, to be dissidents—that is, to provide the error signals which the society so desperately needs if it is to learn.

If we are to continue to be a society which can adapt to changing times, which learns to manage its vexing problems and continues its own progress within the context of a democratic form of government, the system needs three main things: one, more timely information; two, better coordination of existing physical resources and the technical skills which reside in public and private sectors; and three, the reaffirmation of the right, even the duty, of informed citizens to be involved.

Information is the key element—information secured and provided within the context of the rights of men. We must have people who understand both the technology related to many of our problems and the political and social system which determines its use. Men and women with special knowledge have a particular obligation to use that knowledge for the education of the greater populace, for leadership in making the difficult decisions that will always be with us. If you and I are attentive and concerned enough, I believe we stand a good chance of repairing the shaky foundations on which our democracy now stands and carving out a better world for all of us.

Today's vast production of food depends on the energy farmers add to that which the sun provides for their crops. A study of the energy efficiency of crops and cropping methods reveals that more frugal practices can help us expand food supplies despite energy shortages.

*(Photo: Harold M. Lambert)*

Gary H. Heichel
Associate Plant Physiologist
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Experiment Station

# Energy Needs and Food Yields

It is the business of agriculture to collect and store solar energy as food energy in plant and animal products. To collect solar energy, however, farmers must spend fuel energy in tillage, fertilizers, irrigation, harvesting, and processing to help crops convert calories of sunlight into calories of food energy for man and animals. Additional fuel calories are invested in chemicals and machines to hasten the transformation of food calories into meat by animals. All this input of energy by farmers—the fuel, the tractors, the fertilizers, and all the other external sources of energy—I term auxiliary—or *cultural*—energy.

Plentiful and relatively inexpensive food has been available to Americans because the application of cultural energy, through technology and as a result of scientific research, has made farmers able to feed more people with less labor on fewer acres. Most of this productivity results from replacing manual labor with machines and from using fertilizers and pesticides; indeed, because it has largely replaced muscular energy in contemporary agriculture, fuel energy emerges as a major input in agricultural productivity. Now, our concern sharpened by last winter's "energy crisis," we may ask if a future shortage of fuels for farming and farm-support industries foretells a future of scarce and dear plant nutrients and of progressively more expensive food.

Clearly it is important to examine the efficiency with which farmers utilize fuel energy. Do some crops and cropping systems use energy more efficiently than others? Do some animals use the energy in feeds more effectively than others?

My first concern in this paper is the energy consumption of U.S. agriculture in the production of raw agricultural products; this is given perspective by a comparison with the energy use by other U.S. industries. An important aspect of this issue is how the food energy yields of cropping systems respond to the investment of energy in crop production. Finally, I compare the efficiency of energy use in different systems of raising crops and explore some possibilities, without attempting to be exhaustive, for increasing the energy efficiency of agriculture.

## Energy in Modern Agriculture

Fossil fuel energy rivals solar energy as a major input in contemporary agricultural production, but muscular energy from men and animals is virtually obsolete. Substitution of inexpensive fuel energy for expensive muscular energy has made agriculture a significant energy consumer, accounting for perhaps 3.5 per cent of all U.S. energy use. We estimate that farm tractors consumed as fuel about 1.1 per cent and farmers purchased as electricity about 0.5 per cent of the total national energy consumption in 1972. But petroleum and electricity consumed on farms are only part of the energy inputs to agriculture. In 1972, the production of fertilizers, chemicals, feeds, machinery, and other inputs purchased by farmers required another 1.9 per cent of the total national energy consumption.

Agricultural energy consumption is modest compared with that of transportation, which uses 25 per cent of the nation's energy, or that of residential and commercial space heating, which uses about 18 per cent of the nation's energy. Among U.S. industries, however, agriculture ranks third after steel and petrochemicals among the major consumers of energy. Yet 3.5 per cent is a modest commitment, in the sense that the most frugal energy use in agriculture would do little to diminish an impending energy shortfall unless energy conservation also prevailed in other segments of the society.

However, increasingly scarce and dear energy might soon enough lead to less plentiful and more costly food, for food production in the U.S.—and indeed throughout the world—is critically dependent on supplies of fuel, fertilizers, and insecticides. We have little information on what may be called the "price elasticity" of food in relation to energy; that is, we do not know what prices American consumers will tolerate, and therefore we do not know when crop and animal production schemes which are more frugal of fossil fuel energy can be justified. This information is clearly needed, and it is essential to the formulation of an energy strategy for agricultural production. Furthermore, knowledge of energy consumption in present cropping systems is essential before strategies more frugal of energy can be proposed.

## Sunlight and the Food Chain

The efficiency of light utilization by plants is measured as the number of calories of dry matter produced by photosynthesis. This may be computed as the ratio of calories of yield to calories of photosynthetically active sunlight absorbed by the plant. Although the theoretical efficiency of photosynthesis is 12 per cent, wasteful respiration or release of carbon dioxide from photosynthetic products and incomplete capture of sunlight

by leaves throughout the growing season restrict the observed efficiency of most plants to the range of 0.1 to 3 per cent. Indeed, the average acre of corn crop captures only 1 per cent of the $10^{12}$ calories of photosynthetically active sunlight falling upon it during a three-month growing season.

Even fewer calories are available as food for man and beast. The food energy in the harvested crop is generally less than half of the calories of sunlight captured by the entire crop plant. Again using corn as the example, only about 0.4 per cent of the sunlight calories is harvested as food energy in the grain. A further reduction of useful food value occurs when the energy in plants in converted into meat as beef, broilers, and bacon. The live weight gain by broilers is more than double that of hogs, and nearly five-fold that of cattle. The contrast between broilers, hogs, and cattle becomes more pronounced when the rates of live gain are adjusted for dressing percentage. However, these differences are substantially reduced by adjusting the meat to equal water and protein content and computing the efficiency of converting grain to meat on an energy basis. Broilers and hogs return about 0.1 food calories in meat per calorie of feed, but cattle return only 0.05 calorie. Assuming that the energy in feed, expressed as feeding units of corn, is equally available to broilers, hogs, and cattle, broilers and hogs are about twice as efficient as cattle in converting feed calories to food calories. That is, broilers and hogs can produce food energy as meat with 66 per cent less feed energy than cattle.

Cattle and other ruminants can metabolize roughages that are nutritionally worthless to man or to such animals as chickens and hogs. In the U.S., however, cattle are beginning to recede from the role of foragers of the plains and near deserts of the West. Farmers are gathering them into feed lots and feeding them grains and other concentrates in lieu of roughages. We estimate that the 40 per cent of the food energy in our diet that comes from meat and other animal products like butter, eggs, and oils requires over 80 per cent of the feed energy annually harvested from crops. Investing 80 per cent of our feed energy to produce less than half of our diet may not be possible if in the future scarce and expensive fuel results in diminished crop productivity so that animals become more direct competitors of man for his food.

**Energy Consumption of Cropping Systems**

Sunlight used in photosynthesis is free, but the cultural energy used in agriculture grows scarcer and dearer. Clearly we must know where cultural energy is consumed in agriculture and find ways to use it more efficiently. We can obtain this knowledge by analyzing the consumption of energy by agricultural systems of different levels of sophistication. For this purpose, four levels of technology, or application of cultural energy, will be compared in this paper.

A vegetable garden in New Guinea using only human labor is considered as Level I. Level II is represented by rice culture in southeast Asia, where water buffalo supplement human labor. For these two levels of technology, an account of the expenditure of energy by man and beast was the estimate of cultural energy.

Level III is represented by corn culture in the U.S. in 1915, when power from stationary engines was added to horse and human labor. For this level of technology, fuel consumed by engines and energy used to construct and maintain buildings, to house draft animals, to make machinery and implements, and to store crops was classified with human and animal labor as cultural energy.

Several modern cropping systems in the U.S. represent Level IV. Corn for grain and silage, grain sorghum, soybeans, oats, alfalfa hay, rice, sugar beets, sugar cane, peanuts, winter wheat, and potatoes which are crops representing a broad array of cultural energy requirements and digestible energy yields, were analyzed.

In Level IV, tractors and other machines provide the major source of cultural energy for agricultural production. Human energy is required to operate machines, but animal power has become essentially obsolete. Thus the analysis for modern agricultural technology must account for, in addition to human energy, the fossil fuel used in farming and the energy needed to construct buildings, make implements and vehicles, and produce fertilizers and chemicals that are characteristic of modern agriculture.

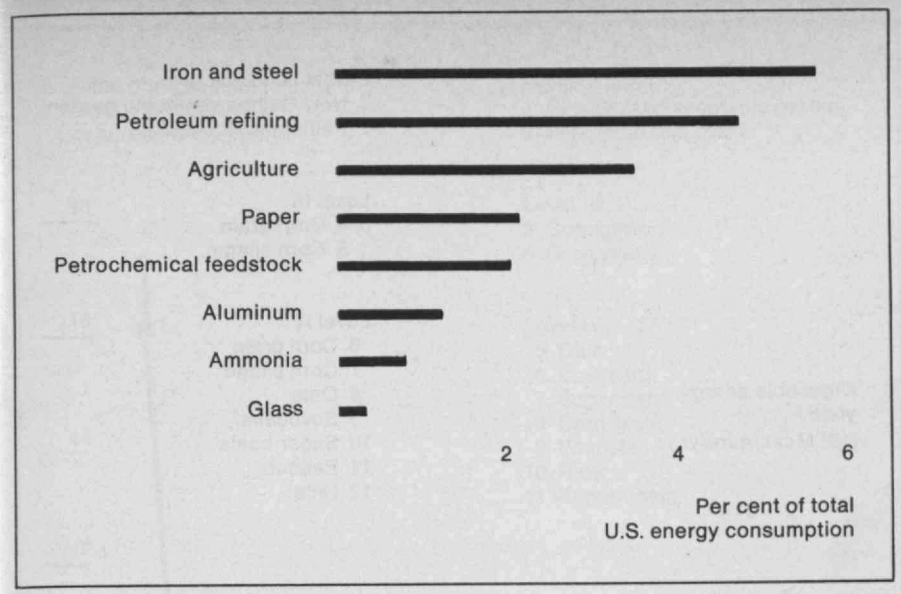
It is now possible to analyze how yields of digestible energy respond to the application of cultural energy among the different cropping systems.

Cropping systems having small inputs of cultural energy, Levels I and II, show low yields of digestible energy. The vegetable garden in New Guinea and rice paddy in the Philippines yield 5,000 to 6,000 megacalories (Mcal) per acre per year from the expenditure of about 200 Mcal./acre/yr. of cultural energy. Digestible yield rises when machinery is combined with draft animals in Level III to supplement the labor of man, and production of corn grain and silage in 1915 (average 8,000 to 20,000 Mcal./acre/yr.) exemplifies this response. It is striking that by 1915, corn farmers in Pennsylvania and Iowa using a far higher level of technology were producing only about 30 per cent more digestible energy than the New Guinea savage or the Philippine peasant.

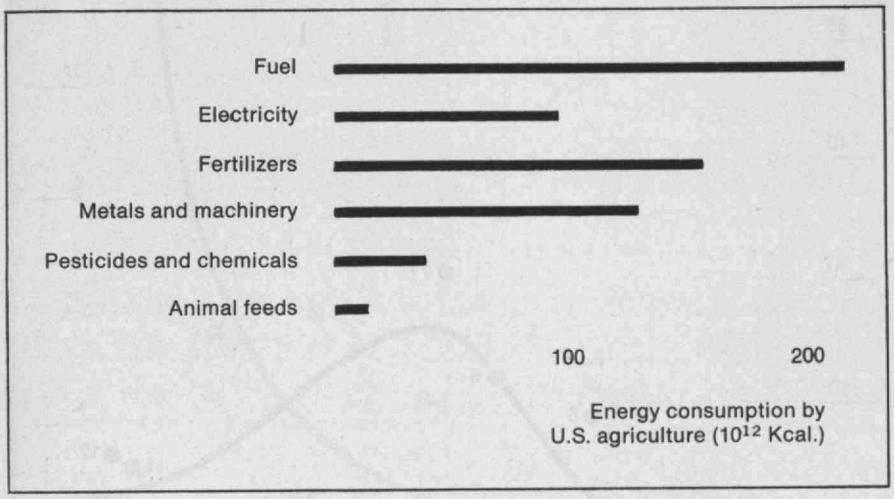
Yields of digestible energy generally increase markedly under modern cropping systems, exemplified by corn for grain and silage now yielding about 23,000 to 32,000 Mcal./acre/yr. for expenditures of about 5,000 Mcal./acre/yr. of cultural energy. But the modern oat farmer in Minnesota (6,000 Mcal./acre/yr.) and soybean farmer in Missouri (8,000 Mcal./acre/yr.) produce no more digestible energy than the corn farmers in 1915 who used substantially less cultural energy. Although the production of winter wheat by modern technology in Montana requires the least energy of the modern cropping systems, it yields less digestible energy than the primitive vegetable garden and rice paddy.

Digestible energy yields of modern cropping systems decline with expenditures of cultural energy exceeding about 5,000 Mcal./acre/yr. This is illustrated by sugar beets, peanuts, and rice, whose culture requires about twice the cultural energy of corn but whose yield is about half the digestible energy. Peanuts grown in North Carolina yield nearly twice the digestible energy of soybeans grown in Missouri—but at the cost of a four-fold increase in cultural energy. Similarly, potato production in Maine uses nearly three-fold more cultural energy, but yields less digestible energy, than the production of corn grain.

For a significant number of modern cropping systems,




Taken as a whole, agriculture is responsible for about 3.5 per cent of U.S. energy consumption. This is small when compared to such broad national uses as transportation (25 per cent) and space heating (18 per cent), but it is significant among such industries as those listed above.




The largest direct input of cultural energy to agriculture is in the form of fuel for farm machines and processes. Major investments of energy which support agricultural production are also made in the manufacture of farm machinery, fertilizers, and pesticides.

a 10- to 50-fold increase in the expenditure of cultural energy per acre yields only a doubling or tripling of digestible energy per acre compared with the more primitive or less sophisticated examples. Thus, substantial expenditures of cultural energy often fail to produce corresponding increases in yield. This response suggests the general proposition that progressively larger expenditures of cultural energy produce less crop output.

**Energy Efficiency of Cropping Systems**

The caloric gain, or the ratio of digestible energy produced to the investment of cultural energy, can be considered a measure of the efficiency of cultural energy utilization. Contrasting the caloric gain among different crops and cropping systems reveals the differences in their energy utilization.

Prior to the use of machines and fossil fuels in crop production (Levels I and II), about 16 calories of digestible energy were harvested for each calorie of cultural energy spent in production. The energy invested was largely human muscle power. When machines were teamed with draft animals (Level III), the output of the cropping systems fell to the range of three to six times the input of all forms of energy.

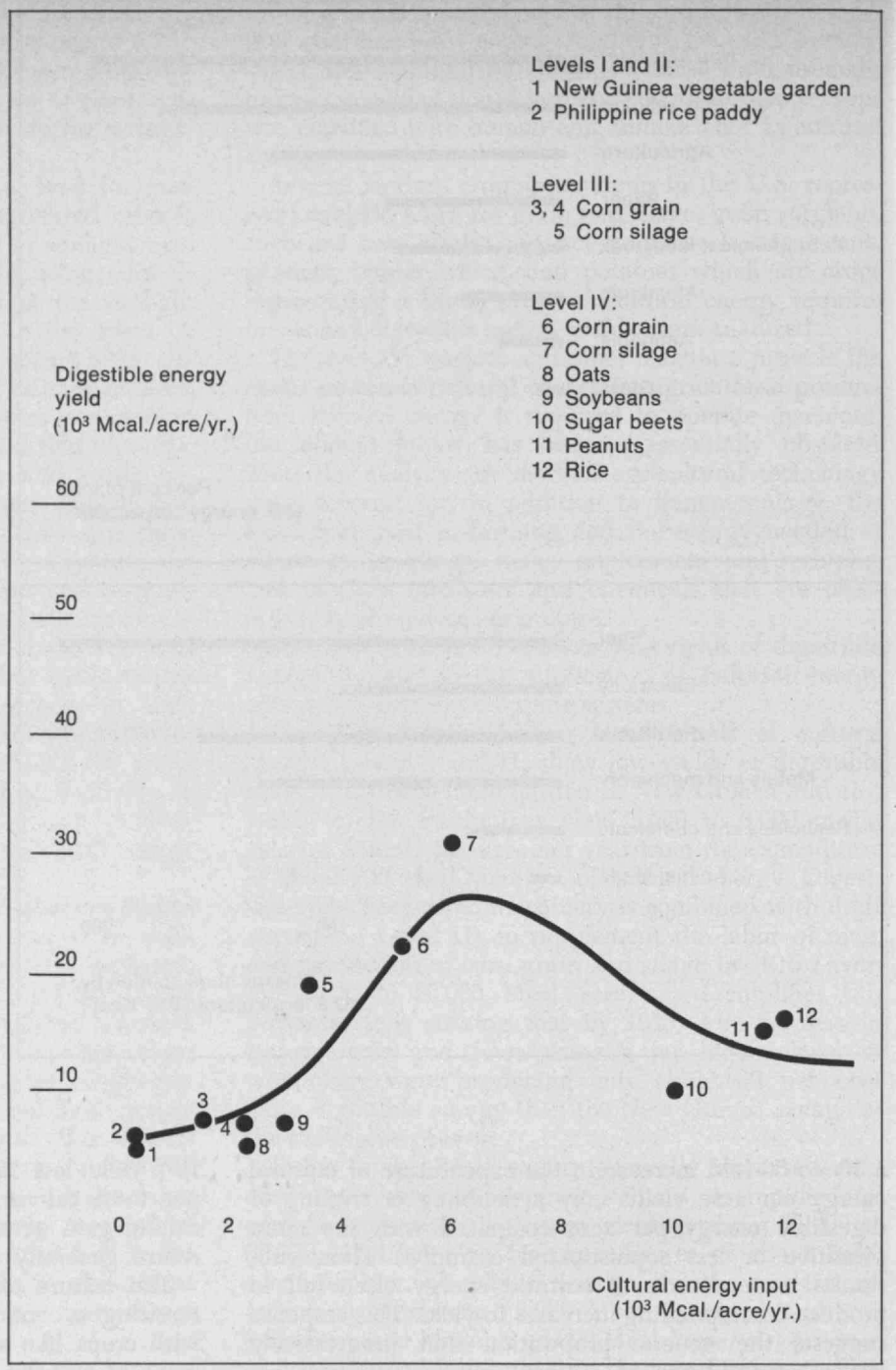
Modern cropping systems in the United States (Level IV) yield less than five calories of digestible energy per total calorie of cultural energy. Comparing the caloric gain of cropping systems reveals that energy return generally decreases with increasing investment.

The culture of corn for grain and silage is an interesting exception to this generalization. Compared with crops like soybeans, oats, or sugar cane, investment of cultural energy in corn production increases energy return. This is possible because of the technological transformation of corn production associated with hybridization. Winter wheat yields twice the calories of digestible energy per calorie of cultural energy as potatoes. The input of a calorie of cultural energy in the production of peanuts and rice is traded for the output of a calorie of energy. More calories are spent in producing sugar beets than are accrued in yield.

Considered on this basis, the most energy-efficient agricultural systems are the labor-intensive vegetable garden of New Guinea and the Philippine rice culture. However, these comparatively efficient cropping systems were also the least productive in terms of digestible energy per acre, and the people dependent upon them are often faced with undernourishment and malnutrition.

Rice is produced with relatively primitive methods

As the author shows, inputs of cultural energy are essential to the production of digestible food energy in all modern cropping systems, and indeed such cultural energy makes possible our present generous food supplies. But some food products and cropping systems yield more digestible energy, and some demand more cultural energy, than others; and in an era of energy shortages it is instructive to understand these differences and perhaps important to capitalize on them. The charts on this and the opposite page show the relationship between cultural energy input and food energy yield for a number of crops grown with only human and animal energy (Levels I and II,) with the aid of farm machines (Level III), and by modern cropping systems (Level IV).



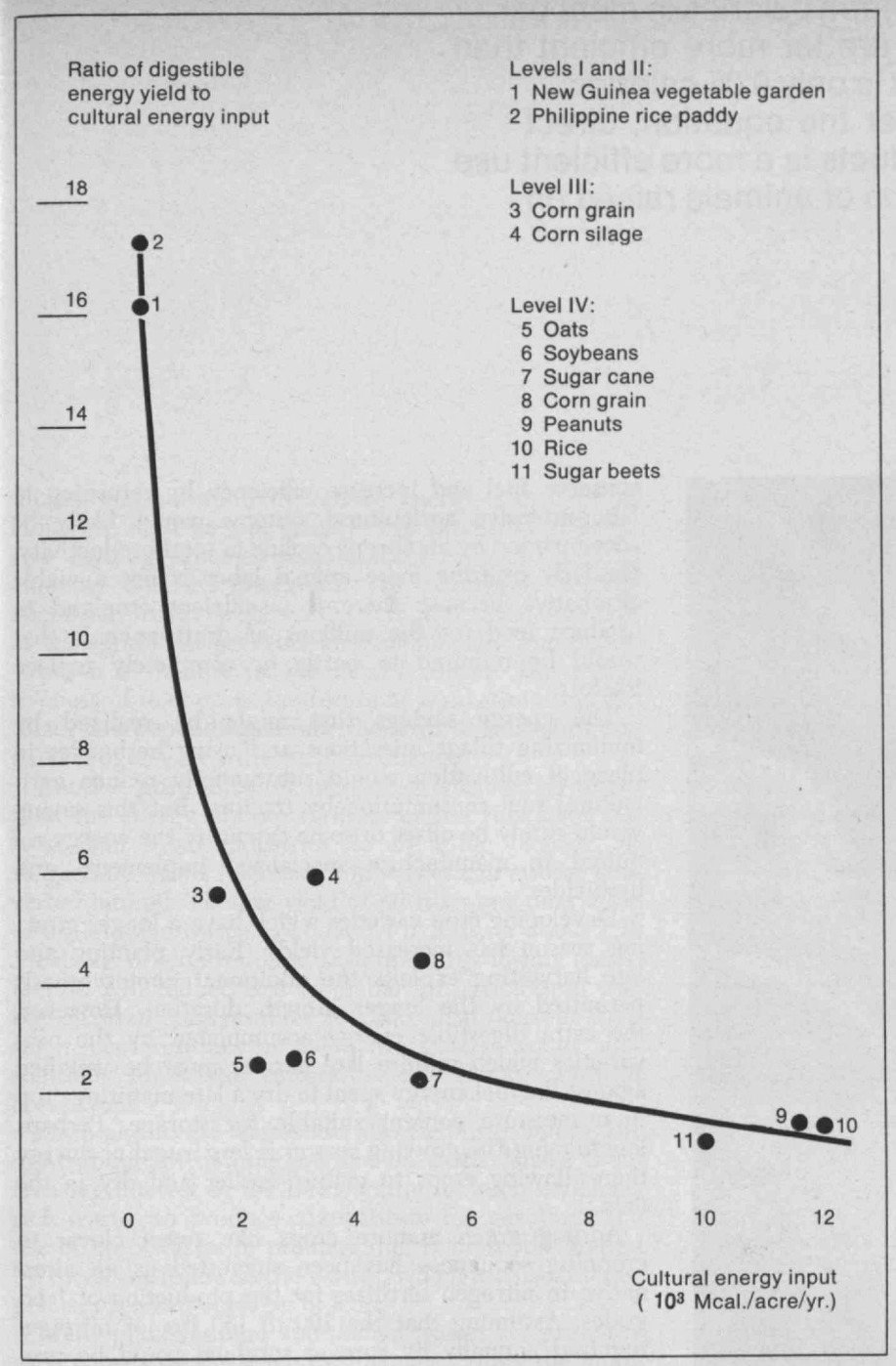

in the Philippines at a very efficient caloric gain of about 16. On the average, however, only six people/acre/yr. can be fed by the meager yields. On an energy-efficiency basis, rice culture in the U.S. is less efficient, but 17 people/acre/yr. can be fed by the more abundant yields. Modern corn production, the most efficient of the modern systems studied, is less efficient than the primitive production of vegetables or rice, but grain from Iowa or Illinois will feed 23 people/acre/yr.

The majority of modern cropping systems return several calories of digestible energy per calorie of total cultural energy; that is, most of the technologically advanced systems that were studied generate far more digestible energy than is spent in cultural energy for production. There is no evidence to substantiate the concern that modern farmers spend more calories in the form of tractor fuel than they retrieve at harvest.

Clearly, high energy efficiency is no asset if it is accompanied by malnutrition or starvation. The response of modern American agriculture to its energy problems should hardly lie in a return to primitive labor-intensive agriculture or to turn-of-the-century mechanization. There are, however, significant differences in efficiency of energy use among modern cropping systems, so it is reasonable to suggest that gains in energy efficiency may be realized by using certain systems rather than others to produce digestible energy.

**Improving Energy Utilization**

Choosing an energy-efficient agricultural system is one approach to frugal energy use, but components of crop and animal production systems might also be changed to improve energy efficiency. Here are some suggestions: Many energy-efficient modern systems in-



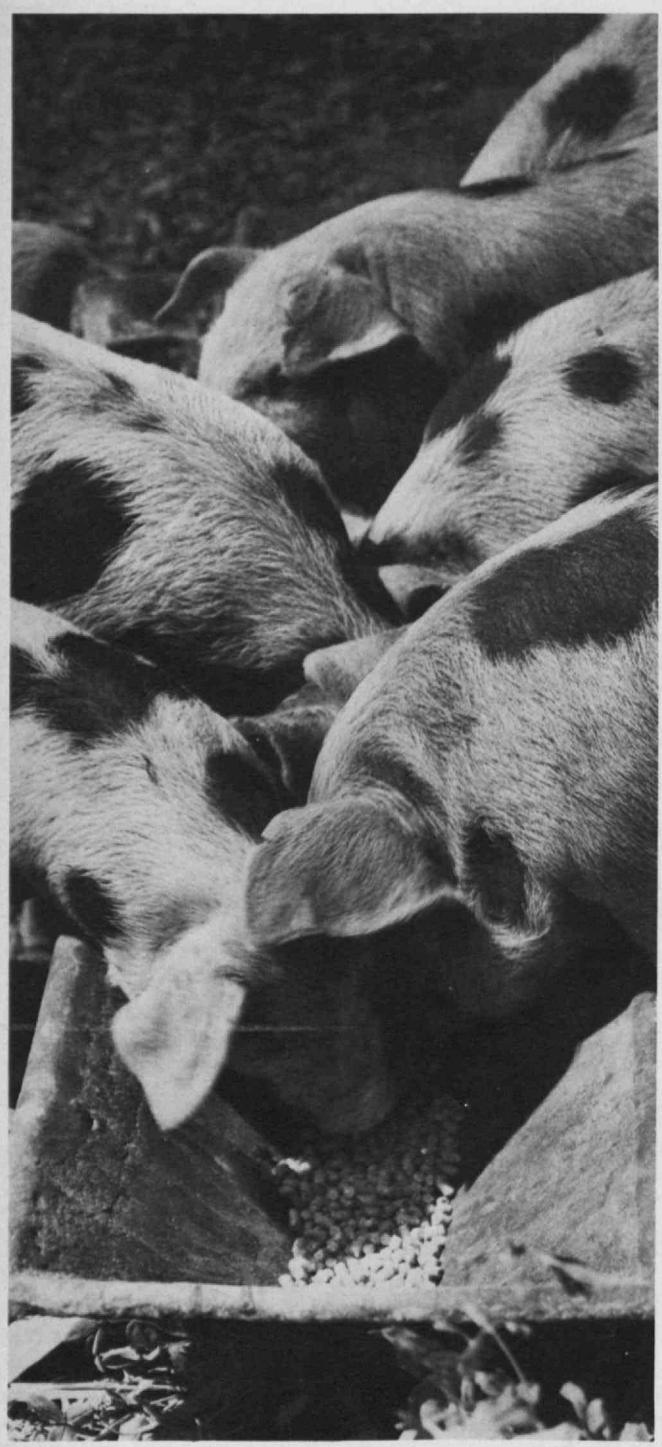

corporate a crop that is comparatively efficient in converting sunlight in photosynthesis. Corn is an example. Thus the use of corn as a feed crop, instead of inefficient species like oats or wheat, might increase energy efficiency while maintaining or increasing productivity. Similarly, emphasizing food energy from a photosynthetically efficient crop such as sugar cane instead of from inefficient species might increase energy efficiency.

Processing crops to make a product that is desirable or acceptable by the consumer requires substantial quantities of energy. About 44 per cent of the cultural energy required to produce cane sugar and about 33 per cent of that required to produce beet sugar is consumed during processing. Similarly, raw potatoes can be produced much more efficiently than processed products, yet we consume nearly 20 per cent of the annual crop as french fried potatoes. Clearly, energy efficiency would be increased by the use of foods that require little processing before consumption, or by our willingness to forego energy-intensive processing of foods which can be consumed in simpler forms.

If the purpose of crop and animal agriculture is the production of food energy, then direct consumption of plant products is a more efficient use of energy than consumption of animals that have been raised on feed grains instead of roughages. Grains are fed to animals to produce meat that is about 17 per cent protein, but soybeans that contain 37 per cent protein can be produced with a substantially greater energy efficiency than meat. Indeed, soybeans clearly produce substantially more protein per unit of energy than broilers, hogs, or cattle.

Fuel accounts for a substantial part of the cultural energy used in modern crop production. However, we have shown examples to suggest that any effort to

**Hogs return only about 0.1 food calories in meat per calorie of feed—but they are far more efficient than cattle, for which the return is only 0.05 calories. Though many factors enter the equation, direct consumption of plant products is a more efficient use of energy than consumption of animals raised on feed grains**



*(Photo: H. Armstrong Roberts)*

conserve fuel and increase efficiency by returning to labor-intensive agricultural systems would likely be accompanied by an abrupt decline in total productivity. Similarly utilizing more animal labor is not a viable alternative because there is insufficient cropland to produce feed for the millions of draft animals that would be required to partly or completely replace tractors.

The energy savings that might be realized by minimizing tillage operations and using herbicides in place of cultivation would substantially reduce agricultural fuel consumption by tractors. But this saving would surely be offset to some extent by the energy required to manufacture specialized implements and herbicides.

Developing crop varieties which have a longer growing season has increased yields. Early planting and late harvesting exploits the additional photosynthesis permitted by the longer growth duration. However, the extra digestible energy accumulated by the new varieties which require late harvest must be weighed against the fuel energy spent to dry a late-maturing crop to a moisture content suitable for storage. Perhaps lengthening the growing season is less frugal of energy than allowing crops to mature earlier and dry in the field.

Adding green manure crops like sweet clover to cropping sequences has been suggested as an alternative to nitrogen fertilizer for the production of feed grains. Assuming that the 100 to 150 lbs. of nitrogen required annually by corn or sorghum could be provided by a green manure growing during the year preceding the grain, then the annual nitrogen requirements of the 91 million acres of corn and sorghum harvested in 1971 might be provided by an equal area of legumes. However, only 18 million acres of land suitable for corn and sorghum and only 37 million acres of total cropland were withheld from production in 1971. We conclude, therefore, given pressure to maintain present productivity of feed grains, that reserves of idle cropland are insufficient for diverting to legumes acreages which are normally devoted to grains. Moreover, green manures would not supply the phosphorus, potassium, or trace elements required by some soils to sustain present levels of productivity.

Another alternative may be more promising. The energy cost of applying animal manures is likely less than that of producing and applying fertilizers, so manures might substitute for part of the chemical fer-

tilizers and substantially reduce energy consumption. However, most animal manures are produced in intensive feeding schemes remote from cropland and in amounts that are inadequate to completely replace chemical fertilizers. At present fuel prices, the high cost of transportation prevents an economically sound substitution of manure for chemical fertilizer. The attractiveness of manure in the future as a substitute for fertilizer will depend upon how the costs of transportation and nitrogen vary with the price of energy.

Another possibility for increasing efficiency is to exploit the energy in crop residues as the Hawaiian and Australian sugar industries do by using bagasse, or surgarcane waste, for fuel. Crop wastes can also be converted into oil. The net yield of oil from one metric ton of dry organic wastes is about 1.4 barrels, or about 1.26 Mcal./kg. of crop residues. Loss of energy during manufacture will reduce that available for agricultural use, but oil from corn residues at 1,500 Mcal./acre or from sugar beet residues at 5,000 Mcal./acre would substantially lower the cultural energy requirements of these crops.

Crop and forest wastes are also rich in cellulose, the most abundant natural product on earth. There is increasing interest in the fermentation of such cellulose-rich wastes to produce a substitute for gasoline. The use of crop wastes to produce fuel is presently limited by the accessibility of the wastes, which are usually dispersed over vast acreages of land.

Many plant residues and animal wastes are presently useless because the chemical linkages joining the molecules cannot be attacked by the digestive enzymes of animals. Lignin, probably the most difficult plant material to degrade, must be aerobically oxidized for maximum degradation, and *in vitro* fermentation is currently used to recycle plant and animal wastes with appreciable lignin. The product of this microbial digestion has a high protein content and appears suitable for supplementing animal feeds. The net energy yield of lignin digestion is not yet known, but the method might solve a serious pollution problem, increase the energy yield of agriculture, and release fuel that is presently needed to produce protein-rich feeds.

## Toward Energy Efficiency

This analysis of energy consumption in agriculture suggests that modern agriculture uses cultural energy 100- to 500-fold more efficiently than plants use sunlight and 10- to 50-fold more efficiently than animals metabolize feed. Though our examination suggests that there are significant differences in the efficiency of energy use among modern cropping systems, the comparatively scarce and expensive cultural energy is used more efficiently in agriculture than the free and plentiful solar energy. Gains in energy efficiency are most likely to be realized by producing food in efficient cropping systems rather than inefficient ones and by developing new systems requiring less energy to produce food. Genetic improvements in photosynthetic efficiency, the use of crops that require little processing before consumption, more extensive use of plants as sources of protein and energy, and the development of frugal cultural practices and the utilization of energy in crop wastes will stimulate energy efficiency and slow the onset of a fuel-related crisis in food production.

**Suggested Readings**

Cervinka, V., W. J. Chancellor, R. J. Coffelt, R. G. Curley and J. B. Dobie, "Energy Requirements for Agriculture in California." Davis, Calif.: California Department of Food and Agriculture and the University of California, 1974.

Heichel, Gary H., "Comparative Efficiency of Energy Use in Crop Production." New Haven, Conn.: Connecticut Agricultural Experiment Station Bulletin 739, 1973.

Rappaport, R. A., "The Flow of Energy in an Agricultural Society," Scientific American 225, 1971.

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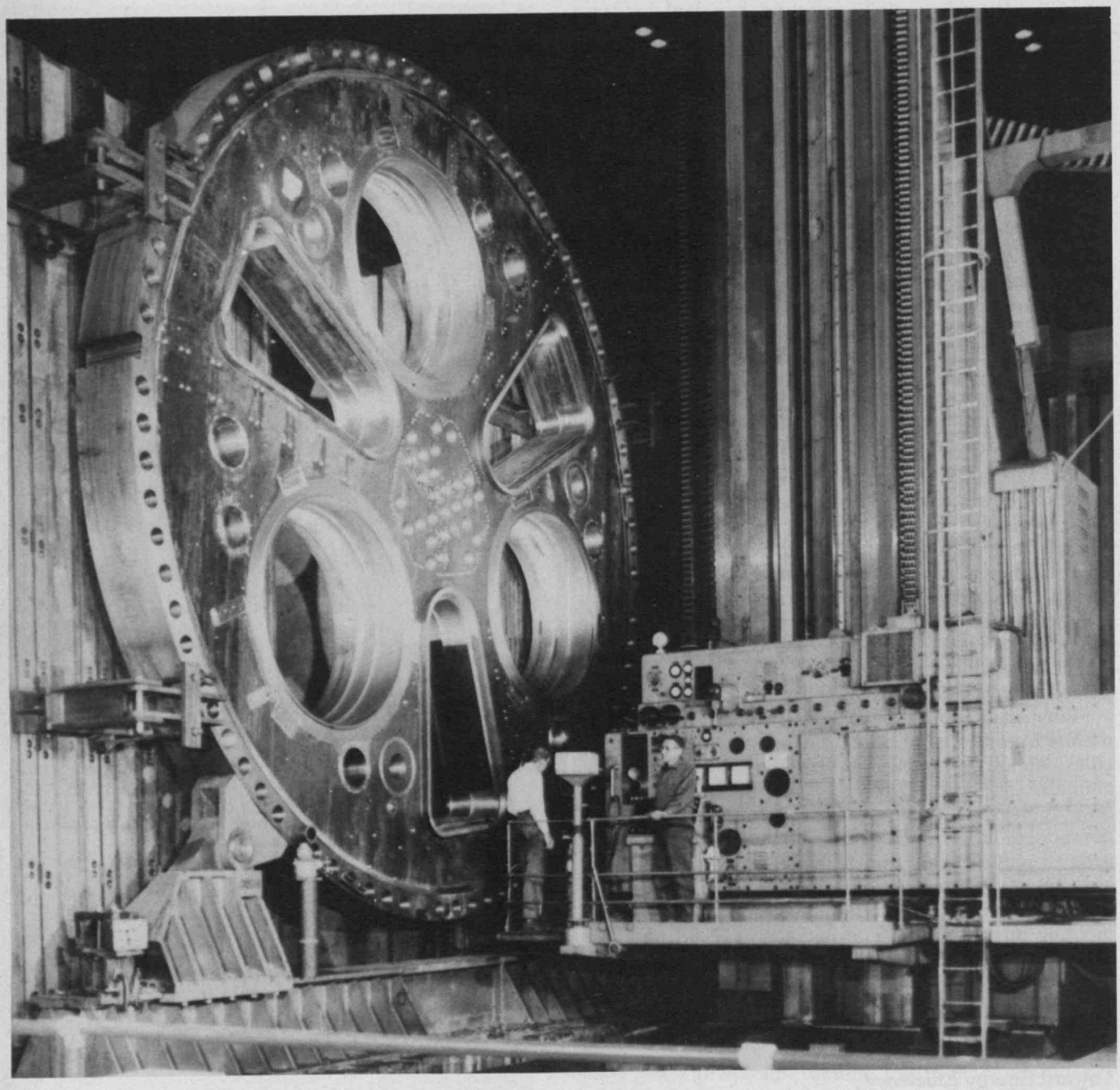
# The Breeder Reactor in the U.S.: A New Economic Analysis



Just half of the total U.S. government energy research and development expenditure in 1973-74 was devoted to the technology of the liquid metal fast breeder reactor—including this head for the Fast Flux Test Facility being built in Hanford, Wash.; the Facility's purpose will be irradiation testing of fuels and materials planned for use in sodium-cooled fast breeder power reactors. Breeder reactor economics remain uncertain, say the authors, and our need for it unconfirmed; they urge a more balanced energy research and development effort. (Photo: A.E.C.)

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For fiscal year 1974 the total federal government energy research and development budget was $998 million. Almost two-thirds of that ($530.5 million) was for nuclear fission programs, of which $473.4 million was devoted to bringing a single technology, the liquid metal fast breeder reactor, to commercial viability. This makes the breeder by far the largest energy research and development program in the nation.

The official justification for the priority assigned to the program has remained quite consistent since the mid-1960s. According to the Atomic Energy Commission, breeder reactors are being developed because they provide the most efficient means of exploiting the energy available in uranium; they minimize the quantity of uranium consumed per unit of electricity generated. Hence, the A.E.C. holds, breeders promise to bring fuel costs below those of the less efficient light-water reactors (L.W.R.s), which currently dominate the U.S. nuclear electric supply system. In sharp contrast with L.W.R.s, the breeder will permit very high utilization (perhaps 90 per cent of the energy potentially available in uranium compared with 1 or 2 per cent for the L.W.R.) thereby extending our energy-producing natural resources by two orders of magnitude.

The physical principles upon which these economies are based are straightforward. All uranium-fueled reactors convert a certain amount of "fertile" $^{238}U$ atoms into fissile $^{239}Pu$ atoms during operation. A reactor can be called a "breeder" if it converts more than one fertile atom to a fissile atom for every fissile atom it burns. Note that even though reactors achieving this kind of "neutron economy" produce more fissionable material than they consume, the total number of fertile atoms available for conversion is ultimately finite.

There are two issues here: Is there any pressing need to extend uranium resources by developing breeder reactors, and can these more "efficient" reactors be expected to produce cheaper electricity?

The purpose of this analysis is to answer those two questions.

The basic economic advantage of the breeder's efficient fuel utilization is that the cost of generating electricity would be virtually independent of the price of natural uranium ore ($U_3O_8$). However, even with the far-less-efficient L.W.R.s the generating cost is only weakly dependent upon the price of $U_3O_8$. Consequently, the potential economic gains in fuel cost promised by the breeder are extremely vulnerable to possible cost disadvantages of the new technology.

Construction cost is the area of chief concern here. It is roughly true that if the construction cost of breeders exceeds that of L.W.R.s by more than $125 per installed kilowatt plant capacity, then regardless of other developments they cannot compete with L.W.R.s. We will demonstrate that if the electricity generated by breeders is to be competitive with that generated by L.W.R.s the allowable differential in construction cost is very small indeed.

**The Uranium Supply Question**

An economic evaluation of breeder reactor development should begin with the general question: How much should one worry about uranium scarcity? Scarcity is not finding the cupboard bare; it is the need for increasing work to produce a given amount of product. Hence, the appropriate questions with respect to uranium reserves is not how much ore exists, but how much is there at various prices.

Some facts are not in doubt:

—According to Organization for Economic Cooperation and Development (O.E.C.D.) figures in 1973, estimated world-wide reserves of $U_3O_8$ ore at low prices ($8-$10/lb.) are about 2.3 million tons (excluding the U.S.S.R. and China). This would probably satisfy world needs for uranium for only about 20 years.

—These estimates should not be accepted as definitive, however, for uranium miners historically have faced very soft markets and they have had little incentive for large-scale systematic prospecting. Enormous areas remain to be explored.

—The worldwide supply curve for uranium is sharply tapered; as price increases, reserves expand prodigiously.

Although these propositions are not disputed, it is difficult to be much more precise. Estimates of high-grade reserves are based upon data only from areas demonstrated to be geologically favorable. No attempt has been made to estimate reserves in areas for which pertinent geological information is not available. Past exploration campaigns in the U.S. and abroad have resulted in discoveries of new geologically favorable areas. The O.E.C.D. study established that known worldwide reserves of high-grade ore increased by one-third between 1970 and 1973. The point is that no one really knows today how much high-grade uranium ore exists; the range of this uncertainty is underlined by the fact that an econometric model developed by the European Community predicts that the ultimate world

resources of high grade uranium will turn out to be 15 times greater than most other present estimates.

Estimates of lower-grade reserves are even more uncertain. The reason is that all systematic exploration to date has been directed toward the discovery of cheap ore. Virtually all estimates of low-grade reserves are by-products of these campaigns and not the result of systematic effort. Therefore, present low-grade estimates must be considered very conservative.

It is evident from the data in the illustration on page 29 that uranium is plentiful in the U.S. even if no additional deposits are discovered. If it becomes necessary to mine uranium at concentrations 20 to 30 times lower than the present $8/lb. ore, at least 7.2 million tons of $U_3O_8$ could be available. At concentrations only 100 times lower than the ore presently mined, 200 million tons become available. To put these numbers in perspective, cumulative demand in the U.S. is generally estimated to be between 2 and 3 million tons by the turn of the century.

Another uncertainty in the uranium supply picture is the cost of mining and processing low-grade ore. However, it is clear that the need to mine lower-grade uranium would mean a significant price increase. (No serious attempt has been made to assess the social costs of the operations.) If, contrary to all available evidence, no substantial additional resources can be found, it may be necessary to accept a five-or-six-fold uranium-price rise by the turn of the century.

What effect would such substantial increases in the price of uranium have on the cost of electricity? The answer is: very little. For example, a rise in $U_3O_8$ price from the present $8/lb. to $18/lb. would increase the cost of electricity "at the switchboard" by only 0.6 mills/kwh. In most areas of the country, it now costs more than 10 mills to generate a kwh of electricity. Thus, the increase in the cost of electricity would, in the worst case, be less than 10 per cent for a more-than-100 per cent increase in the price of $U_3O_8$. This is an extremely inelastic relationship (a given change in the independent variable [price of $U_3O_8$] causes a far less than proportionate change in the dependent variable [cost of electricity]).

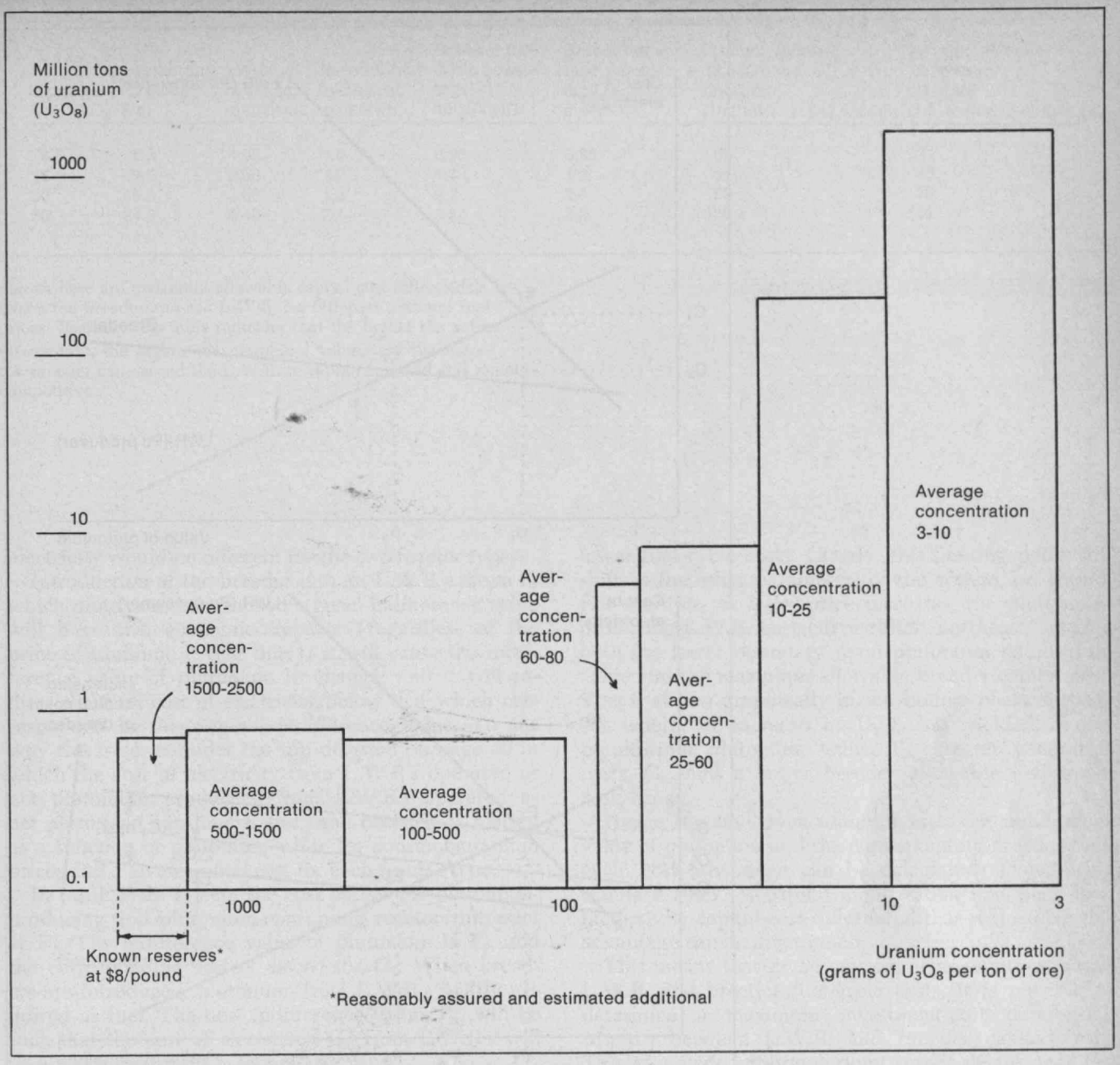
The reason for this inelasticity for L.W.R.s is that the cost of ore is a small fraction of the total cost of electricity. Therefore, a uranium price rise of 5-6 times would only lead to a 3-mill/kwh. electricity cost increase. This seems quite modest for a power-supply system in which costs have increased from 4 mills/kwh. to 20 mills/kwh. in less than 10 years for reasons which have nothing to do with uranium prices.

The qualitative answer to our initial question is therefore pretty clear. How much should we worry about uranium scarcity? Not much. Failure to introduce breeders by the turn of the century would not lead to a disruption of the nuclear power system due to lack of uranium; it would mean only an uncertain but small increase in the cost of electricity. Even this is by no means determinate, for the discovery of additional deposits of high-grade ore is entirely possible. Of course, market-induced shortages of uranium could occur, but this possibility hardly constitutes a case for the breeder reactor. Development of a new technology that will conserve uranium reserves is not a rational solution to potential or actual structural problems of the uranium exploration, mining, and refining industries.

**Breeders and L.W.R.s: Comparative Economics**

The two principal components of the cost of electricity generated by nuclear reactors are the amortization charge for the initial investment in the plant (usually referred to as "capital cost") and the cost of the fuel. For L.W.R.s, capital costs presently account for about 2/3 of electricity cost and fuel-cycle costs for a little less than 1/3. (A third component, operation and maintenance, amounts to about 5 per cent of the total cost.) Absolute fuel-cycle costs are expected to be significantly lower for breeders than for L.W.R.s. We will demonstrate that the capital cost of differential between the two types of reactors can never be allowed to become very large. Unfortunately this entire matter is complicated by the fact that both reactor types produce a joint product: electricity and plutonium.

As a by-product of uranium fission, plutonium has no intrinsic economic value. Its value results from the fact that it can be used in competition with other fissile material as reactor fuel. To date effectively no plutonium, however has been used as a fuel in commercial L.W.R.s. This means that discussion of the economic implications of plutonium production must be somewhat theoretical. Theoretically, in an expanding L.W.R. nuclear electric system in which some reactors are operated as net plutonium producers and some as net plutonium consumers, the value of plutonium should reach equilibrium at a point such that the cost of electricity from pultonium-producing reactors is equal to that from plutonium-consuming reactors. This, of course, is simply another way of saying that a given

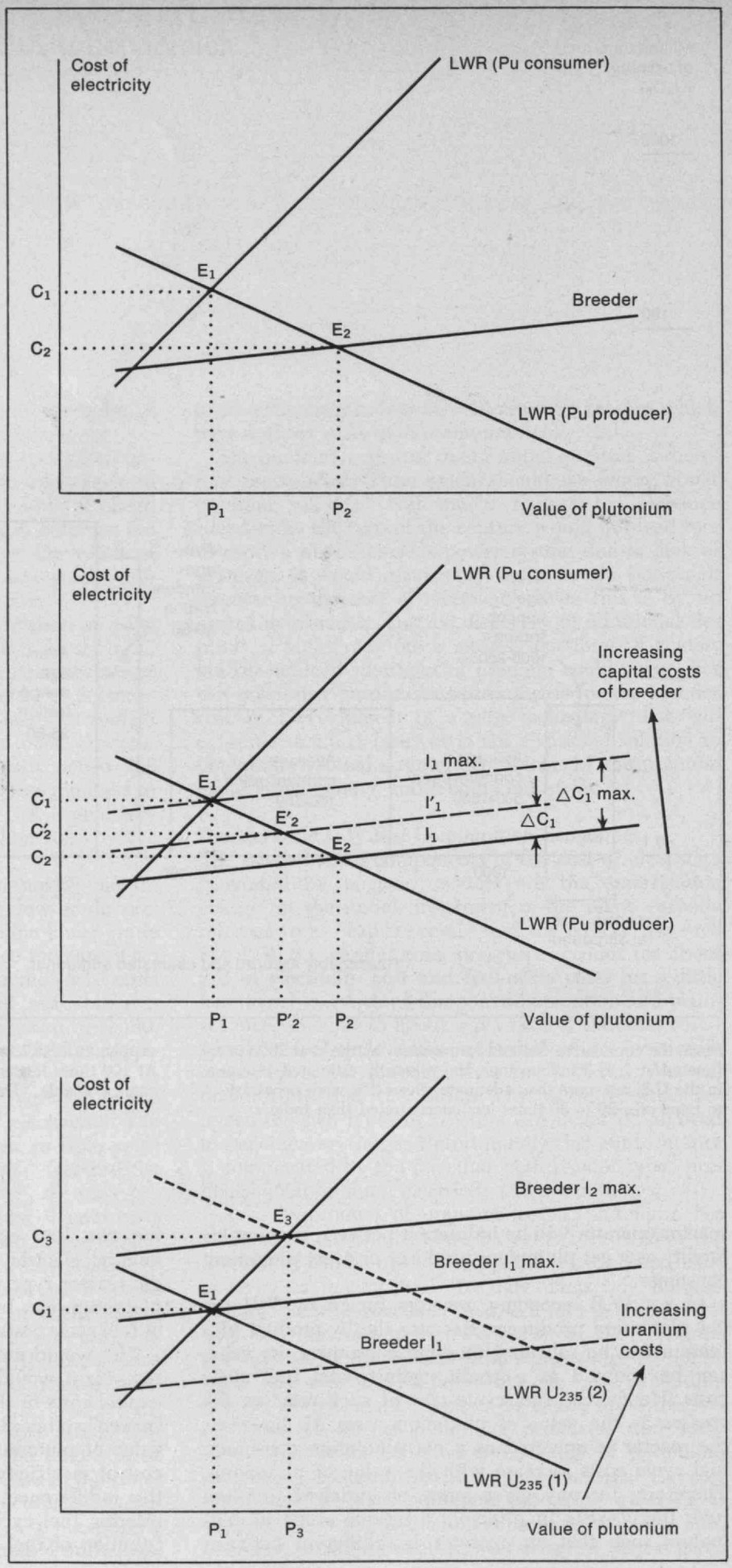



Since the cumulative demand for uranium by the year 2000 is estimated at 2 to 3 million tons, the presently estimated reserves in the U.S. are more than adequate. Even if it were necessary to mine ores 20 to 30 times less concentrated than today's supply, at least 7.2 million tons of $U_3O_8$ would be available. At 100 times less concentration, 200 million tons of ore become available. (Data: USAEC-WASH 1243-April 1973)

reactor operator will be indifferent between running his facility as a net plutonium producer or a net plutonium consumer.

In a L.W.R. economy, reactors fueled by $^{235}U$ are net plutonium producers. Because the by-product plutonium can be sold to plutonium consumers, its value can be counted as a credit against total fuel cycle costs. Hence, the fuel cycle cost of such reactors decreases as the value of plutonium rises. If, however, the reactor is operated as a net plutonium consumer, fuel cycle costs increase with the value of plutonium. Therefore, for any given price of enriched uranium fuel, there exists in principle a unique value of plutonium such that an operator is indifferent between the two fuel cycle modes. Note, further, that in a nuclear electric system characterized by only a single reactor type (L.W.R.), at equilibrium the value of plutonium can be determined by a simple comparison of fuel cycle costs.

This would not be the case in a L.W.R./breeder system, for it would be an astonishing coincidence if the capital costs of the two types were the same. In such a "mixed" system, there would also exist an "indifference" value of plutonium that would be used to equate the cost of electricity between the two reactor types. But this indifference value cannot be determined by considering fuel cycle costs alone, since the relative contribution of fuel costs and capital costs to the cost of




*Top chart:* In a system of mixed reactor types (plutonium consumers and plutonium producers), there is theoretically an "indifference value" of plutonium that equates the cost of electricity between the two kinds of reactors. Keeping the price of uranium and the cost of the two reactor types constant, it can be seen that introduction of the breeder will result in a higher indifference value of plutonium and a lower cost of electricity.
*Center chart:* Increasing the breeder investment cost from $I_1$ to $I'_1$ will raise the cost of electricity from $C_2$ to $C'_2$. There is an investment cost, $I_1$ max., at which the breeder's lower fuel cost is negated and the cost of electricity will be equal to that of the light-water reactor. Above $I_1$ max. it makes no economic sense to introduce the breeder into the L.W.R. system.
*Bottom chart:* The I max. limit will shift when other parameters change, such as the cost of uranium (see the table on the facing page).

| U price $/lb. $U_3O_8$ | Equilibrium Pu price $/g. | LWR fuel cycle cost mills/kwh. | Breeder fuel cycle cost mills/kwh. | Breeder fuel cycle advantage mills/kwh. | Breeder advantage including O & M mills/kwh. | △I max. ($/kwe.) 12.5% fixed charges (1m./kwh. = $42.6/kwe.) | △I max. ($/kwe.) 14.25 fixed charges (1m./kwh. = $36/kwe.) |
|---|---|---|---|---|---|---|---|
| 8.5 | 6.3 | 1.95 | 1.0 | 0.95 | 0.85 | 36 | 31 |
| 15 | 9.5 | 2.50 | 1.2 | 1.3 | 1.2 | 51 | 43 |
| 30 | 16.0 | 3.80 | 1.6 | 2.2 | 2.1 | 89 | 76 |
| 50 | 24.5 | 5.40 | 2.1 | 3.3 | 3.2 | 136 | 115 |

Shown here are maximum allowable capital cost differentials between the breeder and the L.W.R. for different uranium fuel prices. Basically this table indicates that the higher the prices of uranium, the higher the plutonium value, and the more the breeder can exceed the L.W.R. in capital cost and still remain competitive.

electricity would be different for the two reactor types.

Introduction of the breeder into an L.W.R. system in which plutonium has reached a given indifference value will have two economic impacts (regardless of the price of uranium at that time): it will cause the indifference value of plutonium to change; and it will reduce the total cost of electricity below that which corresponded to the original indifference value. To see why this is so, consider the top diagram on page 30 in which the cost of electricity from L.W.R.s operated as net plutonium producers, from L.W.R.s operated as net plutonium consumers, and from breeders is plotted as a function of plutonium value for constant uranium prices and a given capital cost for each reactor type.

In the L.W.R. system the cost curves for plutonium-producing and plutonium-consuming reactors intersect at $E_1$. The indifference value of plutonium is $P_1$, and the corresponding cost of electricity, $C_1$. When breeders are introduced, plutonium from L.W.R.s will be required as fuel. The new indifference value, $P_2$, will be such that the cost of electricity, $C_2$, from L.W.R.s will be equal to that from breeders.

The actual equilibrium value of plutonium in a mixed nuclear electric system will be strongly dependent upon the financial characteristics of the reactor types. From the center chart on page 30, it can be seen that any increase in breeder investment cost, from $I_1$ to $I'_1$, would generate an electricity cost increase $\Delta C_1$, all other things remaining constant. This increase would lead to a different equilibrium value of plutonium, $P'_2$ and a consequent higher generating cost, $C'_2$.

It makes sense to introduce the breeder into an L.W.R. system in which some reactors are operating as net plutonium producers and others as net plutonium consumers *only* if the cost of electricity from the mixed system is lower, or at worst, equal to cost $C_1$. Otherwise, it would be more profitable to refuel L.W.R.s with the plutonium produced by the uranium-fueled reactors rather than use it as fuel in a machine (i.e., the breeder) that produces more expensive electricity. Corresponding to this maximum generating cost, $C_1$, is a maximum allowable breeder capital cost, $I_1$max. This represents the largest capital cost that a breeder can afford without offsetting the advantage it derives from lower fuel cycle costs. Clearly, this limiting point will shift as the other parameters of the system are varied. For example, as $U_3O_8$ price increases, the plutonium-producing-L.W.R. cost curve shifts "northeast," raising both the lower boundary upon plutonium equilibrium value and the maximum allowable breeder capital cost. This is shown graphically in the bottom chart on page 30, where an increase in $U_3O_8$ has yielded a new equilibrium plutonium value, $P_3$; greater generating costs, $C_3$; and a larger breeder allowable investment cost, $I_2$max.

Hence for any given uranium price, an indifference value of plutonium and the corresponding breeder fuel-cycle cost advantage can be calculated. Then, using standard rules for capital amortization and plant-load factors, the capital-cost differential that will cancel this advantage can be determined.

This means that given any set of assumptions about L.W.R. and breeder fuel-cycle costs, it is possible to determine a maximum investment-cost differential, $\Delta I$max., between L.W.R. and breeder capital costs. This is a very important point, for it means that the maximum allowable capital-cost differentail is independent of the absolute investment costs of the respective reactor types. The table on this page gives the values of allowable capital-cost differentials for various $U_3O_8$ prices.

The critical economic issue for breeder reactors should now be clear: there is no reasonable way by which the breeder fuel-cycle cost advantage can become much larger than 3 mills/kwh. as a consequence of uranium price changes. At 14.25 per cent fixed charges—and even this is now considered too low by many utility industry executives—this means that the maximum capital cost differential for the breeders to be competitive can never be much higher than $100/kw. Moreover, if significant additional high-grade uranium reserves (i.e., $15/lb. or less) are discovered, the allowable margin will be less than $50/kw.

It might be argued that the U.S. reactor and reactor-fuel markets are not in fact truly competitive and that therefore an equilibrium analysis can at best give only an oversimplified and approximate idea of the behavior of plutonium prices. Two comments are in order:

| | 1967<br>Plant on operation<br>by 1970[1] | 1970<br>Plant on operation<br>by 1974-75[2] | Early 1973<br>Plant on operation<br>by 1981[3] | Late 1973<br>Plant on operation<br>by 1983[4] |
|---|---|---|---|---|
| Capital | 2.58 | 6.31 | 11.30 | 16.52 |
| Operation and maintenance | 0.28 | 0.38 | 0.64 | 1.66 |
| Fuel | 1.63 | 1.87 | 2.30 | 3.11 |
| Total cost of electricity | 4.49 | 8.56 | 14.24 | 21.29 |

*All figures in mills/kwh.*

[1]U.S. Atomic Energy Commission, WASH 1098, November 1967.
[2]Manson Benedict, Electric Power from Nuclear Fission, Bulletin of the Atomic Scientists, Sept., 1971.
[3]M.I.T. Center for Policy Alternatives
[4]A study of base load alternatives for the Northeast Utility System, Arthur D. Little, Inc., July, 1973.

| Fuel cycle cost (in constant 1967 dollars) | |
|---|---|
| 1967: | 1.63 mills/kwh. |
| 1970: | 1.62 mills/kwh. |
| 1973: | 2.18 mills/kwh. |

Cost trends of L.W.R. power generation between 1967 and 1973 are all sharply up, except those of fuel cycle, which have remained low chiefly as a result of economics of scale. When current dollars are converted to constant dollars, the fuel cost increase is flattened even more.

First, there necessarily exists an absolute lower limit to plutonium value: zero. Although it is completely implausible that plutonium would ever have zero value in a market where the price of other fissile material is increasing, the existence of this theoretical lower boundary makes it possible to calculate another maximum allowable capital-cost differential for the breeder to be competitive. With entirely "free" fissile material and $U_3O_8$ at $15/lb., breeders cannot compete if their capital costs are more than $85/kw. greater than L.W.R.s.

Second, in an imperfect reactor-fuel market characterized by increasing uranium prices and perhaps long lead times for fuel-reprocessing operations, actual plutonium prices would probably differ from the idealized market price predicted by equalibrium analysis. Calculations made in 1969 by the A.E.C. suggest, however, that for at least the first 20 years following breeder introduction, this price (the so-called "shadow price") would be far greater than the equilibrium values considered in the foregoing analysis. Therefore, the economic advantages for the breeder shown in the table on page 31 are, if anything, conservative.

Before drawing further conclusions from the figures, and tables, it will be helpful to examine recent trends in actual nuclear fuel cycle costs and capital costs in more detail. The table at the top of this page summarizes the salient trends of nuclear electric power L.W.R.s between 1967 and 1973. It is difficult to draw precise conclusions from this data since all the numbers represent current dollars. It is nevertheless very clear that between 1967 and 1973, fuel cost estimates have remained generally stable while capital costs have increased strikingly. This is confirmed in the accompanying table, in which the fuel-cycle cost estimates have been approximately adjusted to constant dollars. The basic reason for the relative stability of fuel costs is that increases in the cost of raw materials and labor have been offset by scale economies and improved efficiencies.

The table below shows that the combined cost of uranium ore and of enriching the $^{235}U$ is about 75 per cent of total fuel-cycle costs for an L.W.R. What is more important, though, is that the elasticities of fuel-cycle costs to changes in ore price or in enrichment cost are quite small—about the same, actually, in both cases. John Vernon (Public Investment Planning in Nuclear Power, 1971) calculates coefficients of 0.35 and 0.36 respectively.

Can decreases in enrichment costs reasonably be expected? There is actually some evidence to the contrary. The A.E.C. charge for enriching uranium has risen from $30/kg. in 1965 to $37/kg. in 1973. Once again, this is in current dollars; in constant dollars the increase is trivial. However, A.E.C. projections for the cost of enriching uranium during the 1980s are in the $50-$55/kg. range. But the inelastic relationship be-

| | Contribution to total fuel cycle cost of light water reactor |
|---|---|
| Uranium | 34 per cent |
| Conversion | 4 |
| Enrichment | 41 |
| Fabrication | 21 |
| Reprocessing | 8 |
| Pu credit | −8 |

In the case of the boiling water reactor (L.W.R.), using 1970 figures, the cost of uranium ore represents less than 35 per cent of total fuel-cycle costs; the cost of enrichment was of roughly equal significance. As the author points out, the elasticities of fuel cycle costs to changes in ore or enrichment cost are small.

| | March 1967 | June 1969 | January 1971 | January 1973 | February 1973 |
|---|---|---|---|---|---|
| Total cost (plant and interests) in current $ | 129 | 201 | 274 | 409 | 422 |
| Interest during construction | 11 | 31 | 53 | 90 | 95 |
| Plant cost in current $ | 118 | 170 | 221 | 319 | 327 |
| Inflation* | 0 | 12 | 43 | 85 | 97 |
| Plant cost in 1967 $ | 118 | 158 | 178 | 224 | 230 |
| Per cent increase on plant cost | 0 | 34 | 51 | 90 | 95 |

*Handy-Whitman Deflator index for Steam Electric Plant Construction

In constant (1967) dollars, which is a more realistic way of viewing cost increases, the investment cost (in dollars per kilowatt) of L.W.R. plants has about doubled between 1967 and 1973. Despite the fact that about 300 such reactors were operating, under construction, or on order, the industry has not yet learned enough to reduce capital costs. Thus the future costs of L.W.R.s cannot be estimated with confidence. (Source: Statement of M. Shaw, USAEC-FY 1974. Authorization hearings before the Joint Committee on Atomic Energy, March 14, 1973.)

tween fuel-cycle costs and enrichment costs means that even a doubling of the latter would result in only some 0.7 mill/kwh. increase in the cost of electricity. Alternatively, even cost-free enrichment would reduce the present cost of nuclear power only about the same amount.

Also, because entirely new fabrication and reprocessing capacities will have to be built to meet increasing demand, these costs may increase during the next decade. Such cost increases would further penalize the breeder, for it is generally admitted that they will be greater for breeder reactors than L.W.R.s.

There is no reasonable way by which changes in the cost of enrichment, fabrication, and reprocessing could substantially modify our initial conclusion about the size of the maximum allowable capital-cost differential.

### Nuclear Generating Plant Investment Cost Trends

In the mid-1960s, it was widely believed that large L.W.R. plants could be built for $125/kw. or less. By 1971, estimates for plants scheduled for operation in 1979 were as high as $400/kw. Now, in 1974, estimates for plants to go on line in 1983 exceed $700/kw. All these figures are in current dollars. Several explanations have been suggested for what appears to be a virtually exponential increase. For example, it has been argued that L.W.R. construction experience demonstrates how very large projects can encounter subtle and interacting circumstances that can require costly solutions in terms of commercial design.

The problem is that this increase represents a combination of several separate effects whose relative importance is by no means obvious. First, there is simple monetary inflation. The second element is what could be called the direct financial effect of construction delays (which may be attributable to labor difficulties, licensing difficulties, or material and equipment procurement problems). The major effect of these delays is to increase, perhaps quite substantially, the total amount of interest a utility has to pay on the funds it borrows to build a reactor. On the average, U.S. privately owned utilities rely upon external capital sources for approximately two thirds of their capital funding requirements. Another effect of delays in construction is to increase the direct manpower costs. The final element of cost increases is unscheduled increases in the scope of the project which have mainly been caused by extra equipment needed to meet changing nuclear safety and environment protection standards.

In the table at the top of this page we have attempted from various A.E.C. cost estimates to isolate some of these major elements. The sixth row of this chart shows the changes in L.W.R. capital costs after allowance has been made for inflation and interest during construction. We see from these calculations that the proportionate increase in constant dollars in the real scope of reactor project between 1967 and 1973 was about 100 per cent. So, the increase in L.W.R. investment cost is not altogether a monetary illusion. Reactors are today at least twice as costly to build per kw. as they were expected to be when utilities first began to purchase them in the mid-1960s. Moreover, these cost increases are today continuing in spite of considerable construction experience. As of December 31, 1973, approximately 200 reactors, representing an aggregate capacity of 196,000 Mw. were in operation, under construction, or on order. These continuing increases are important for they mean that we still cannot be really confident about future L.W.R. capital costs. In addition, continuing capital cost increases in conjunction with constant fuel-cycle costs means that the latter represent a decreasing fraction of the total cost of electricity from nuclear power.

It does not seem reasonable, therefore, to claim definitive economic benefits on the basis of an allowable cost differential which represents a decreasing fraction (now less than 20 per cent) of the cost of a relatively well-known technology, whose real cost we still cannot confidently predict and a new product whose cost is highly uncertain.

### The Cost/Benefit Approach

Another way to look at the economics of breeders is to compare the expected aggregate costs of development with total discounted benefits.

In principle, of course, benefits can be easily calculated for any assumed economic advantage of breeders over L.W.R.s. For example, it is an altogether trivial exercise to show that an assumed capital-cost differential of $40/kw. less than the maximum allowable for any set of fuel costs would produce benefits to society of more than $12 billion dollars by the turn of the century (assuming only 200 breeders $\times$ 10 years (1990-2000) $\times$ 1 mill/kwh. $\times$ 6100 hrs./yr.). But this, or any other, assumed differential can only be sheer guess. For in general, the uncertainty about the actual capital cost of all nuclear plants is so high relative to the total cost

that the benefits of breeder introduction can be predetermined by selecting a set of cost assumptions that have no more empirical validity than any other set.

Cost/benefit analysis of a problem as complicated and uncertain as breeder development requires a number of assumptions, many of them necessarily somewhat arbitrary:

—the level of electricity demand in the long term

—the relative long-run investment cost of breeders versus L.W.R.s

—the availability and the long term cost of uranium

—the rate of introduction of the new technology.

The A.E.C. has attempted three successive cost/benefit analyses of the breeders. Because of changes in these critical assumptions, the results have been strikingly different in each case. Using the A.E.C. reference scheme for each of these studies and the same 10 per cent discount rate, the results are summarized in the table below.

These increasing "benefits" may be pleasing to the proponents of early breeder development and introduction but they can hardly be very comforting to a decision-maker trying to allocate scarce resources among alternative energy policies.

Another major difficulty with this kind of approach is making proper allowance for the very important "learning effect" in the production process. For a time the breeder will have to compete with a product that will have been in production for a certain period. It is well known that if a new product is roughly the technological equivalent of an older one (as is the case with the L.W.R. and the breeder), one cannot expect the latter to become competitive until a certain number of units have been produced. Until this happens, the manufacturer of the new product is obliged to absorb additional costs per unit corresponding to the difference at any time between the positions of the two products on their respective "learning curves." It has been established by a number of empirical studies that as a general rule, the logarithm of the cost of a product is a decreasing linear function of the logarithm of the number of units that have been produced. Therefore, the manufacturer of a new product has to introduce his product more rapidly than units of the older one are being built.

These general propositions are directly pertinent to breeder introduction. Breeders will not be competitive with L.W.R.s when only 10-20 of the former have been installed as opposed to several hundred of the latter. Consequently, an added cost will be incurred by breeders until their manufacturing costs have decreased enough to compensate for the initial L.W.R. advantage due to fabrication experience. These learning-curve costs must be taken into account even if it is assumed that breeder capital costs will turn out to be below the allowable threshold for previous $U_3O_8$ prices and other variables. In such circumstances, learning curve costs have to be subtracted from the breeder advantage in order to determine the real benefits of their introduction.

The magnitude of these costs depends upon a number of different parameters: the slope of L.W.R. and breeder learning curves, the costs of the first L.W.R. and the first breeder on their respective curves, and the "lead time" between the points at which L.W.R. and breeder costs begin to decrease. All of these critical parameters are now very uncertain.

The capital costs of L.W.R.s continue to increase. Even though 200 machines have been sold, we still do not know their true commercial characteristics. The only possible evidence that a product is on its learning curve is decreasing cost as a function of incremental production. Any claim of definitive economic advantage from breeder introduction must therefore take account of costs due to learning effects, which could quite easily turn out to be a substantial multiple of research and development costs.

| *All figures in billions of dollars* | | Date of A.E.C. cost benefit analysis | | |
|---|---|---|---|---|
| | | 1970 | 1972 | 1974 |
| Date of breeder introduction | 1986 | 1.6 | 4.3 | 19 |
| | 1990 | −0.1 | 1.1 | 16 |

In three successive cost/benefit analyses (in terms of net discount benefits), the A.E.C. came out with remarkably different results for each. This is attributed to changed assumptions in electricity demand in the long term, long-run relative investment costs of breeders and L.W.R.s, availability and long-term cost of uranium, and rate of introducetion of new technology.

**Conclusion**

The economic prospects for breeders in the U.S. are dominated by uncertainty. The only thing we can say with confidence is that if breeder construction cost is more than about $125/kw. greater than the L.W.R.'s and if uranium costs roughly $8-15/lb., there is no reasonable prospect that the new technology will be competitive. Conversely, if breeders can be built at a capital-cost differential of about $50/kw. or less and if uranium prices rise above $50/lb., then, notwithstanding the inelasticity of electricity cost to that of uranium, the cost of electricity almost certainly will rise high enough to make the breeder competitive. All intermediate cases are to a greater or lesser degree uncertain. The situation is summarized in the table on page 36.

The uranium-supply issue is a critical key to breeder development in the U.S. We do know that uranium is an abundant resource in this country. Consequently, the future supply of uranium is definitely not a question of physical availability or dependence upon a foreign source; it is a question of cost and time scale. Development of breeders in the U.S. cannot therefore be justified by claims that the technology is needed to insure "self-sufficiency" or to prevent a disruption of fuel supplies for reactors. Hence, comparisons with the current petroleum situation are inappropriate. This situation might be different, however, for European countries, which have only about 13 per cent of proven U.S. high-grade uranium reserves to satisfy needs that are roughly the same.

## The Breeder and Uranium Efficiency

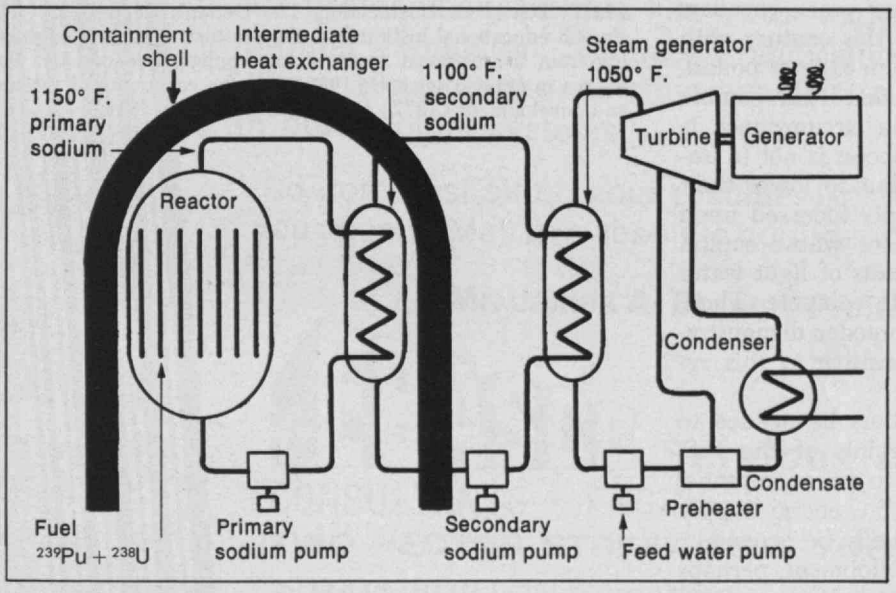
The major known advantage of the liquid-metal fast-breeder reactor over the light-water reactor (the predominant nuclear power source in the U.S. today) is that it utilizes natural uranium over 100 times more efficiently. By substituting the breeder for the L.W.R. we could in effect increase our available uranium fuel supply by two orders of magnitude. (The economic relationships of the two in the production of electric power are another story, as pointed out in the accompanying article.)

In nature uranium is composed of 99.3 per cent $^{238}U$ and 0.7 per cent $^{235}U$. The L.W.R. is fueled with an enriched uranium, in which the fissionable isotope $^{235}U$ is brought up to 3 per cent. The reactor fuel core is cooled by pressurized or boiling water which carries the heat of fission to the steam generator. Fast neutrons emitted during spontaneous fission of $^{235}U$ atoms are slowed down by the water, a moderating or energy-robbing process that occurs when neutrons collide with hydrogen nuclei in the water. The slow neutrons more readily react with other atoms of $^{235}U$. In L.W.R.s the reactor cores are so configured that the flux of slow neutrons supports a self-sustaining chain reaction.

As light-water reactors are currently operated 99.3 per cent of the uranium is wasted. Most of the non-fissionable $^{238}U$ is discarded in the original enrichment process, part of it is discarded during fuel reprocessing, and part of it is converted into plutonium ($^{239}Pu$) and stockpiled.

The liquid-metal fast-breeder reactor can utilize almost all of the $^{238}U$ by converting it into fissionable $^{239}Pu$. The breeder core, considerably more massive than that of the L.W.R., is fueled with plutonium and is surrounded with a blanket of fertile $^{238}U$. Fast neutrons given off in the spontaneous fission of plutonium are not moderated by the reactor's liquid-sodium coolant. For every neutron absorbed by a $^{239}Pu$ atom 2.5 neutrons are produced, one of them sustaining the chain reaction and the other 1.5 converting $^{238}U$ into plutonium. The mass of the blanket is so great that in fact the neutrons are slowed down, thus enhancing the conversion of $^{238}U$.

Actually the L.W.R. is a breeder of sorts, in that it converts 0.5 or 0.6 atoms of $^{238}U$ into plutonium for each atom of $^{235}U$ burned. Some technologists have suggested that L.W.R.s can be modified to utilize the plutonium. Others have rejected the idea as unfeasible and particularly hazardous due to severe emergency-core-cooling limitations. In any case, the liquid-metal fast-breeder reactor is the one that is under development and its chief promise hypothetically is that it makes considerably more uranium fuel available for electric power production.—*R.S.*




In the breeder reactor the plutonium-239 fuel is surrounded by a blanket of fertile, but non-fissionable, uranium-238. For each fast neutron reacting with (splitting) a plutonium atom 2.5 fast neutrons are emitted, one of them producing another fission and the other 1.5 converting the uranium into plutonium. At appropriate times the reactor core materials are reprocessed into new plutonium fuel elements. In the liquid-metal fast-breeder reactor molten sodium—chosen for its high thermal conductivity and heat capacity—transports heat from the reactor through a primary plumbing system at 1150°F. For safety, since the sodium is highly radioactive, the heat is transferred to a secondary non-radioactive sodium system, which in turn provides the energy for a steam generator (1050°F.). Electric power is produced by a conventional turbine-generator system.

The economic prospects for breeders are summarized here: the question is whether they can compete. The breeders will certainly compete with L.W.R.s if uranium prices undergo a manifold increase and if their investment cost is only slightly more than that of L.W.R.s. On the other hand they will certainly not compete if uranium price remains in today's range and if their investment cost is more than $125 more than that of L.W.R.s. All intermediate cases are more or less uncertain.

| Capital cost differential between LWRs and breeders | | | | |
|---|---|---|---|---|
| | >$125/kw. | Definitely No | Probably No | Uncertain |
| | ~$50-125/kw. | Probably No | Uncertain | Probably Yes |
| | ~$50/kw. | Uncertain | Probably Yes | Definitely Yes |
| | | ~$8-15/lb. | ~$15-50/lb. | >~$50/lb. $U_3O_8$ price |

There is no special economic virtue in a reactor with a breeding ratio greater than 1.0 to satisfy the future electrical energy needs of the United States. Such machines are only a way to produce cheaper electricity than L.W.R.s when uranium prices have increased by several times. When this will happen is also a matter of complete uncertainty. The only rational way to reduce this uncertainty is to acquire much better information than is presently available about the uranium supply curve. We urge that a systematic program to develop such data should be a top priority of a national energy policy.

If significant additional deposits of high-grade uranium are to be found in the next few years, breeders will have to compete by the turn of this century with L.W.R.s using uranium costing less than $15 per pound. Our analysis has highlighted the fact that if the gamble to develop the breeders under these circumstance is taken, the key to their commercial success is not to improve their fuel cycle performance but to lower their capital cost. Attention must be sharply focussed upon the need to develop a breeder reactor whose capital costs are roughly equivalent to the costs of light water reactors against which it will have to compete. There is reason to doubt that the present breeder demonstration-plant program is sufficiently sensitive to this requirement.

Advanced technologies will doubtless be needed to satisfy long-range needs and constraints of the U.S. energy system. If nuclear fission is to be an essential component of the long-term U.S. energy-supply strategy, breeder reactors will eventually be economic. Consequently some research and development, perhaps publicly funded, is a reasonable part of a national policy. On the basis of present knowledge, however, it seems reasonable to allocate the limited funds available for energy research and development in a more balanced fashion among programs that vary in the uncertainty and time scale of their benefits.

We consider it questionable, at best, to continue to give top priority to a single, very long-range program. In our view the top priority should be to build economic and safe light-water reactors. This is a technology to which at least $100 billion has already been committed. The costs of continuing failure to get this technology on its learning curve far outweigh the uncertain benefits of early introduction of breeders.

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As man's numbers and leisure increase, his relationships with wildlife change in both quality and quantity. What are the appropriate goals for wildlife management today, and how shall we reach them?

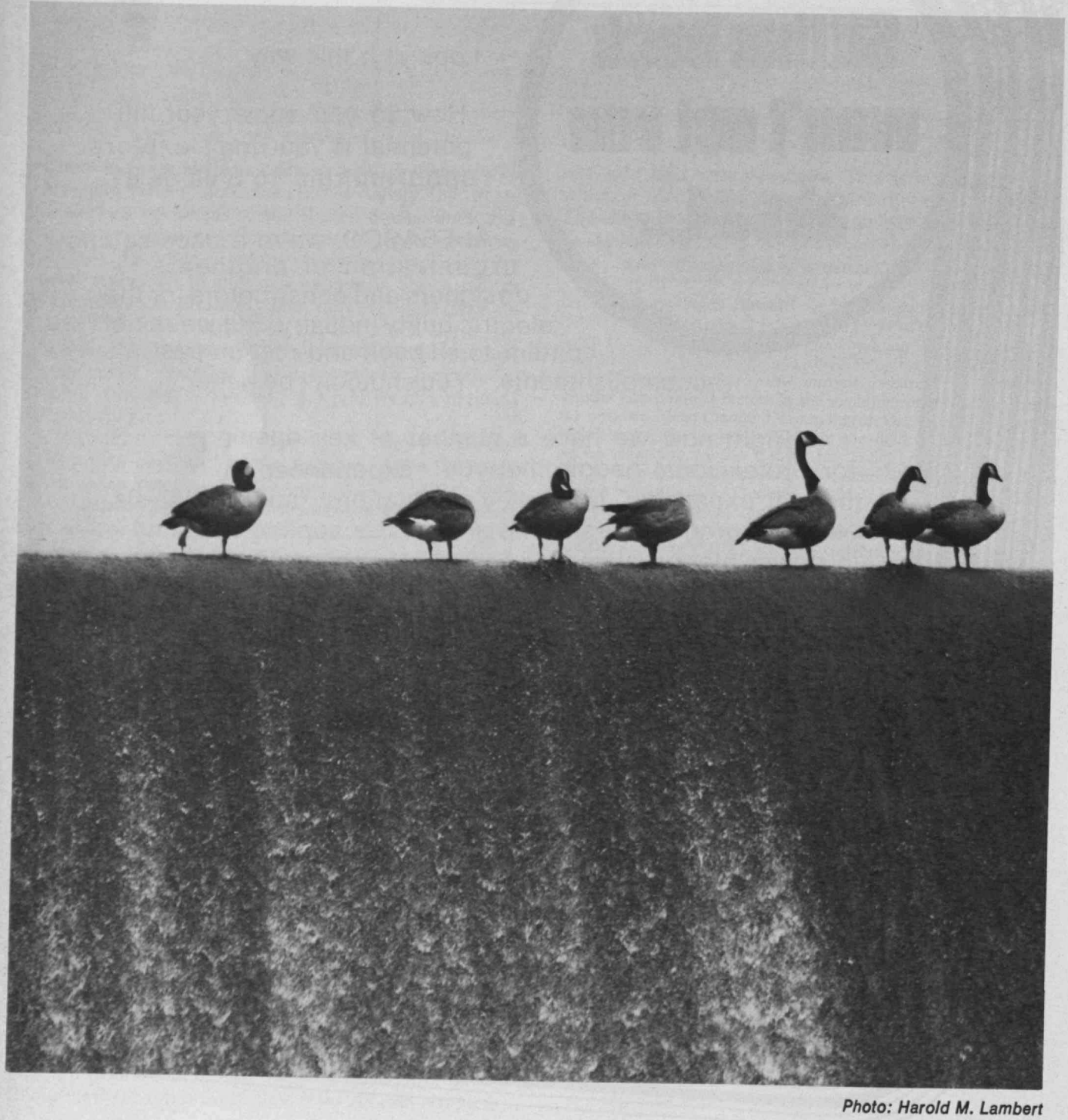

Photo: Harold M. Lambert

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# Technology and Wildlife

Art and literature are rich with proof of humanity's ancient and continuing intimacy with wild things. People enjoy most wild creatures, need many, and wage war on a few. For their part all nonhuman organisms must reckon with man as the wild card in their environmental deck, the joker that can change the course of every game. The process of wildlife management has developed out of the modern complexity and urgency of these relationships, one of several fields of wildland stewardship.

The term "management" is more than a small smugness, implying a level of control over natural events which few field biologists pretend to exert. More accurately stated, wildlife managers try to influence animal numbers in response to human needs and simultaneously to modify public and private actions in response to the necessities of wildlife's welfare.

Itself a technology distantly akin to agriculture, wildlife management is hugely influenced by the technology of materialism which has impelled a tidal wave of human population, modified global environments, vastly multiplied human mobility, veiled our intimacy with nature (while sharpening our scientific perceptions), and provided tools of unprecedented keenness for biotic manipulation. This article explores some of those relationships.

**On Environmental Change**

In at least a general way the fact that mankind has affected global environments measurably and local environments catastrophically has become part of conventional wisdom. A growing number of people now realize that—disruptive as technologic man's effects on global ecosystems have been so far—much graver changes seem certain in the future. The 20th century's population explosion has become a worldwide contract for ensuing decades of accelerated resource extraction, intensified land use, and increased pollution, even if population control campaigns were to achieve full success tomorrow. We in the North have our own example of that truth, as we watch resource-hungry Japan buy timber stumpage, mineral properties, real estate, fish, and petroleum throughout Alaska and Canada.

Among the several important effects of the environmental changes which man increasingly effects, extinction of species most thoroughly captures the popular imagination. Whatever the specific factors in an organism's demise—habitat destruction, competition with introduced exotics, overexploitation, and others—the underlying problem is that organisms are unable to adapt to environmental modifications as fast as man can cause those changes. Vertebrate animals, for example, attuned to nature's glacial pace, generally cannot be recast into genetically isolated new forms (species) in less than 10,000 years. Compare that with the rapid modern engorgement of lakes with polluting nutrients, the nearly-instantaneous rise in mean temperature of streams receiving cooling-water discharges, and the global spread of toxic contaminants since mid-century, and it becomes obvious why extinction rates are rising sharply. Over 360 of the world's 65,500 vertebrate species are gone since 1600.

Species extinctions are important in themselves. But they are especially significant as symptoms of deeper and more pervasive ecosystem changes. Few natural biotic communities (in the sense of plant-animal associations negligibly affected by man) now exist in the earth's temperate or semi-arid regions—the former receiving the brunt of modern technological development and the latter the accumulated effects of millennia of pastoralism. Ecosystem disruption in the semitropical and tropical regions is patchy, often severe, and sharply increasing. We are at the brink of extensive resource exploitation in the boreal forests and arctic tundras of North America, which until now remain largely undisturbed.

What is meant by ecosystems disruption? Six main processes are involved:

- *Loss of species from a locality.* For every species that has become totally extinct there are dozens lost from local biotic communities.
- *Substitution or addition of species.* Thousands of plant and animal species have been carried around the globe piggyback on man's uncaring shoulder. Some have turned out to be useful; more are pests or worse.
- *Changes in the balance between various biologic communities within a region.* Human actions may set the clock of terrestrial ecosystems either forward or backward. Freshwater ecosystems are more often examples of the former as they are thrust ahead to more advanced stages of maturation through nutrient overloading and siltation; but New England forests—in which the number of youthful "seral" associations has been increased at the expense of self-perpetuating "climax" forms—are an example of the latter.
- *Addition of exotic chemicals.* Man's activities may

The northern caribou was once threatened by the guns of protein-hungry prospectors. Is it now threatened by petroleum-hungry men whose protein needs are fulfilled at the expense of the Wyoming pronghorn?

*Photo: Harold M. Lambert*

be responsible for introducing naturally-occurring compounds in abnormal concentrations, for adding synthesized compounds and where they have heretofore been unknown, or for creating chemicals as a result of unforeseen synergistic reactions occurring in soil, air, or water.

- ☐ *Simplification of energy networks in ecosystems.* When a forest is cut, for example, there is a net decrease in solar energy fixation and biotic production—at least temporarily—on that land.
- ☐ *Losses of soil or water fertility.* Man's activities commonly cause topsoil erosion, hardpan development, nutrient leaching, and chemical poisoning.

**Values: Positive, Negative, or Neutral?**

Admittedly these processes do not have the same value or even "sign" to everyone. One can argue, for example, that the eastern bluebird simply received what was inevitable at the hands of the European starling, or that the world is no worse off now that Hawaii's unique endemic avifauna is largely replaced by feathered hitchhikers. There is no reason to conclude that climax vegetation is uniformly better or worse than seral types. Well informed people often sort such information through widely differing value systems.

Wildlife managers certainly are no exception. We have often weighed environmental changes against a rather confining set of priorities. To exaggerate, if an organism wasn't game, game food, or a game predator, it was just part of the scenery. We were not—are

not—above tampering with ecosystems ourselves by importing foreign species of game and sport fish, poisoning and restocking lakes, and otherwise manipulating habitats. The profession came by those priorities honestly, for hunters and fishermen supply essentially all of the funding for state wildlife conservation programs.

Now the social responsibilities of wildlife managers are broadening rapidly under the influence of an internal activism, new (especially urban and preservationist) constituencies, and the social involvement made possible by the National Environmental Policy Act and its yardstick of ignorance, the environmental impact statement. We are beginning to understand how superficially we comprehended John Muir's comment that everything in the universe is tied to everything else. Today when the ancient enmity between Arab and Israeli threatens Bostonian air, Dakotan prairie, and Alaskan tundra alike we can even extend Muir's universe of nature to include human economic, technologic, and political systems.

However unsatisfying the wildlife profession's present priorities may be, the basis for a new set which might serve us better remains elusive. If we are not to manage for "game," for what are we to manage? The only candidate system in sight is based on species rarity or extent of endangerment, hardly a comprehensive basis for ecologic action. "Ecosystems management" rolls nicely off the tongue, but without specified objectives it amounts to biologic anarchy.

**On Demand and Carrying Capacity**

It is obvious that the growth of human population and the technology which supports it have greatly changed patterns of human demand for wildlife resources. Not all the new patterns involve increased consumption. For example, food processing and transportation technology have made it cheaper for arctic petroleum work camps to put beef on the table than caribou, in contrast to the heavy pressure which market hunters exerted on caribou, moose, and other game in earlier gold rushes. (However, temperate zone wildlife now bear the particular burden of arctic exploitation, since range cattle displace native browsers and grazers and feedlot cattle commit wildlife habitat to grains.)

But the net outcome of increasing human population and of increasingly sophisticated and demanding technology is to greatly increase demand for wildlife yields, whether commercial or recreational. World demands for protein and major improvements in oceanic fishing and processing technologies have rendered every stock of large or abundant fish vulnerable to overexploitation. The open ocean (a relatively poorly stocked pantry) is still a commons where no law restrains the fisherman. On richer fishing grounds nearer shore where nations exert their territorial imperative more firmly, a complex, cumbersome, and often unenforceable structure of treaties, commissions, laws, and regulations has grown out of the need to protect as well as exploit fish stocks.

Commercial or quasi-commercial demands raise critical conservation problems for other wildlife as well. One regional example is the harvest of Africa's hoofed game for meat. Proposed by ecologists as a more efficient means of protein production than grazing with goats and cattle, "game farming" African style simultaneously offers an economic rationale for protecting savanna and plains ecosystems from destructive pastoralism but poses the threat of overexploitation. World commerce in fur provides a worldwide example of a new issue in wildlife stewardship. Demand for furs from wealthy nations has resulted in serious threat of extinction to dozens of tropical and subtropical mammals. The complexities and urgencies of fur animal preservation were the subject of multi-national discussion and resolution in Stockholm in June, 1972, and September, 1973. Whales are another group of wildlife in serious danger from past and continuing commercial utilization, and they again illustrate the ineffectiveness of human institutions in dealing with international problems.

**Where On the Scale Should Be Leisure?**

Industrial production technology has imposed leisure upon millions of people, permitted storage of energy in the form of savings, and provided the mobility necessary to close the physical gap between the city dweller and the hinterland. Impelled by boredom and compelled by green promises of recreation, photographers, hikers, birdwatchers, artists, tourists, sportsmen, and collectors of nature's *mementos mori* have driven towards nature in hordes. Any notable wildlife spectacle can attract viewers from every wealthy nation at the drop of an adman's pencil. No outstanding resource can escape being overwhelmed unless carefully guarded from overzealous hunting and voyeurism.

Indeed, wildlife and wildland managers now realize that wildlife and natural environments can be destroyed as surely by the so-called nonconsumptive users as by

"... The photograph is a substitute for experience, two-dimensional and subtly treacherous. . . . The photographer must concentrate ever more on the process and paraphernalia of photograph, ever less on his relationships with nature."

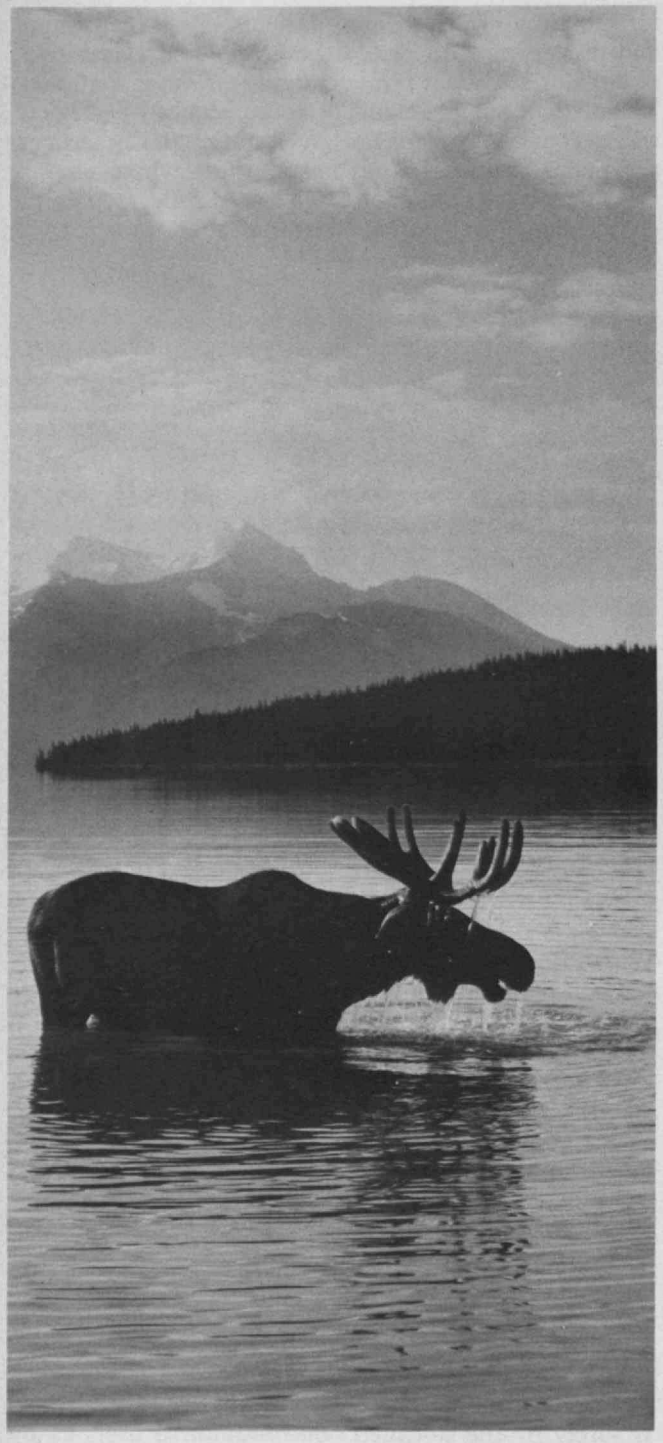


*Photo: H. Armstrong Roberts*

hunters and fishermen who "consume" individual wild animals. One of the wildlife profession's critical tasks is to redefine "carrying capacity" in terms of the leisure-time exodus. In its traditional biologic context, carrying capacity is a simple abstraction: the ability of an area or ecosystem to absorb stress without disruption of its basic properties. Under given environmental conditions a deer range can be used by only so many deer without overbrowsing, and the deer herd can sustain a definable maximum harvest. But if the area is stressed by snowmobiles, plant collectors, school science projects, and pack trains as well as hunters; and if as a decision-maker you need a unit of production more basic and broadly applicable than harvestible deer (as, for example, human satisfaction); then the old idea of carrying capacity is useless. "Wildlife habitats" which we have heretofore described biophysically become mysterious, pychologically defined "settings" for human activities, and the easily quantified "harvest" becomes the incommensurable "experience." Revealed for what it is, carrying capacity in contemporary terms results from a complex interaction of ecologic, economic, and cultural use.

The tremendous surge in outdoor recreation demand since World War II has been a function of increased mobility as well as wealth and leisure. Internal combustion engines and roads have brought vast areas of our continent under the influence of urban recreationists. But increased leisure and mobility have worked the other way, too: By making recreation a big business, the automobile (to use the car as a symbolic component of the overall phenomenon) has created a political constituency favoring open space preservation, wildlife conservation, and recreation opportunity in general. Thus, for example, the automobile has both destroyed and created recreation resources; but on balance I suspect its destructive powers are greater. Perhaps the main reason is not that highway construction directly destroys wildlife habitat and other recreation assets (which it does) or leads to mass use of recreation areas that degrade water quality and wildlife living space (which is also true); it is that dependence on the car has fostered a kind of outdoor experience in which personalized interactions with the real world of nature are diminished. "Outdoor recreation" for most people has come to mean spectatorship, socializing with family, friends, or strangers, or having an affair with a gadget.

There was a time when, if roads were at least five or ten miles apart, a center strip remained where human

usage was light: most recreationists couldn't bear to be out of sight of their cars. It was even possible to argue that new roads in unsettled areas of the West, Canada, and Alaska actually made more wilderness experiences available to people willing to walk a lunch away from the highway. Production and marketing of snowmobiles, trail bikes, and the less zany but almost unstoppable all-terrain vehicles changed all that in a few years of exponential off-road vehicle growth. Today's recreationist waddles to the verge of the wilds in a bulging truck, plucks a brace of off-road vehicles from his marsupium, and swarms across the landscape for a day of respite from city traffic noises. His staccato burps, blue-grey fumes, and spaghetti tracks greedily consume space, silence, and others' pleasure. Unless a serendipitous fuel shortage stalls the growth of such usage, the problem will resolve in a spectrum of uneasy zoning compromises, each landowner responding to whatever political pressures, personal preferences, and ecologic constraints are prominent in his environment.

**On the Veil Between**

A few years ago a young, city-bred nephew visited my home in Alaska. Observing with growing wonder how we gathered berries and mushrooms for the table, grew vegetables, and harvested salmon and game for the winter, he finally commented, while my wife mixed powdered milk for lunch, "I sure like the way you make everything at home. Mom always buys her milk at the store in a bottle."

The psychological distance between the average urban dweller and soil, energy flow in biotic systems, and the un-Bambi-like life of wild things has drawn much comment in recent decades. The results show clearly in many current political debates about resource use, such as clearcutting in national forests and hunting. In theory, at least, the majority of city residents, who have sufficient income to leave the city on vacations, should be able to contact nature and natural processes often enough in person to reinforce the proxy exposure gained through communications media. In practice a very large number do travel into the open countryside, but once there they find that the physical distance is far easier to overcome than the intellectual-emotional distance.

I referred earlier to two of the reasons for this situation: the tendency to assume the spectator's role, and the common fixation on recreational gadgetry. The first is important because a spectator focuses on what *is*, with little interest in what *was* or *will be:* process is relatively unimportant in comparison with event or momentary state of being. A spectator expects no interactiveness and may take steps to insure that none occurs. Not surprisingly, he finds little relationship between himself and the scene or object that comprises the spectacle.

The second is not a matter of passivity but misdirected action. The sportsman hunts for game but *attends* to his admirably machined rifle and sighting scope, his specially constructed pack, his jackknife-of-all-trades. The wildlife photographer finds a wild animal at close range and backs off, eye to viewfinder, to get far enough away to keep his monstrous lens from seeing too little. For the picture-taker the comsummation is the photograph, his certificate of experience, his trophy, his ego trip. For the viewer at home the photo-

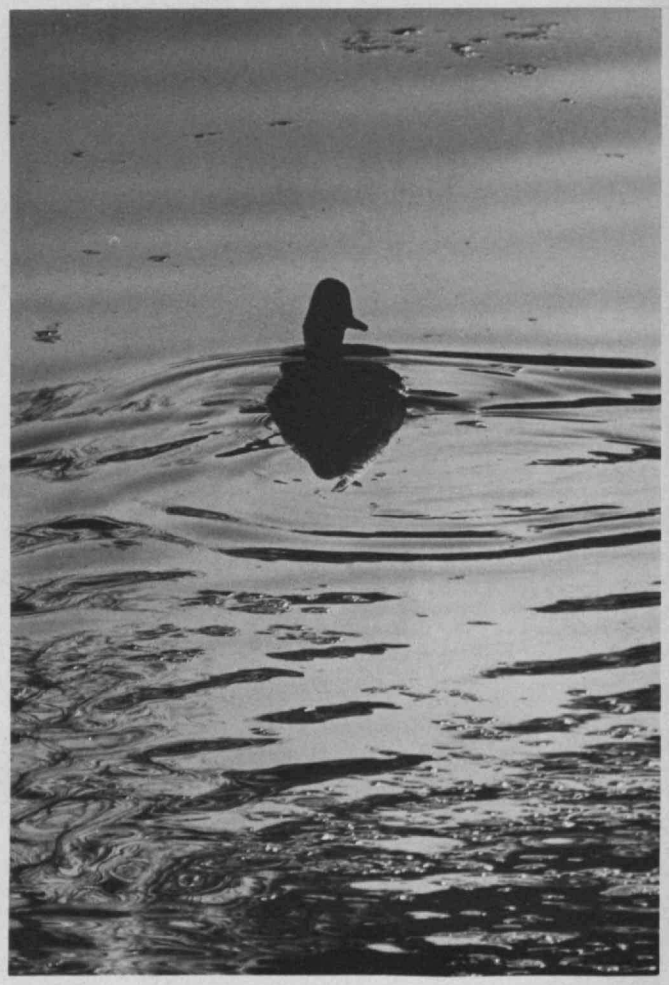


*Photo: Harold M. Lambert*

"... the underlying problem is that organisms are unable to adapt to environmental modifications as fast as man can cause those changes."

"Any notable wildlife spectacle can attract viewers from every wealthy nation at the drop of an adman's pencil. No outstanding resource can escape being overwhelmed unless carefully guarded from overzealous hunting and voyeurism."

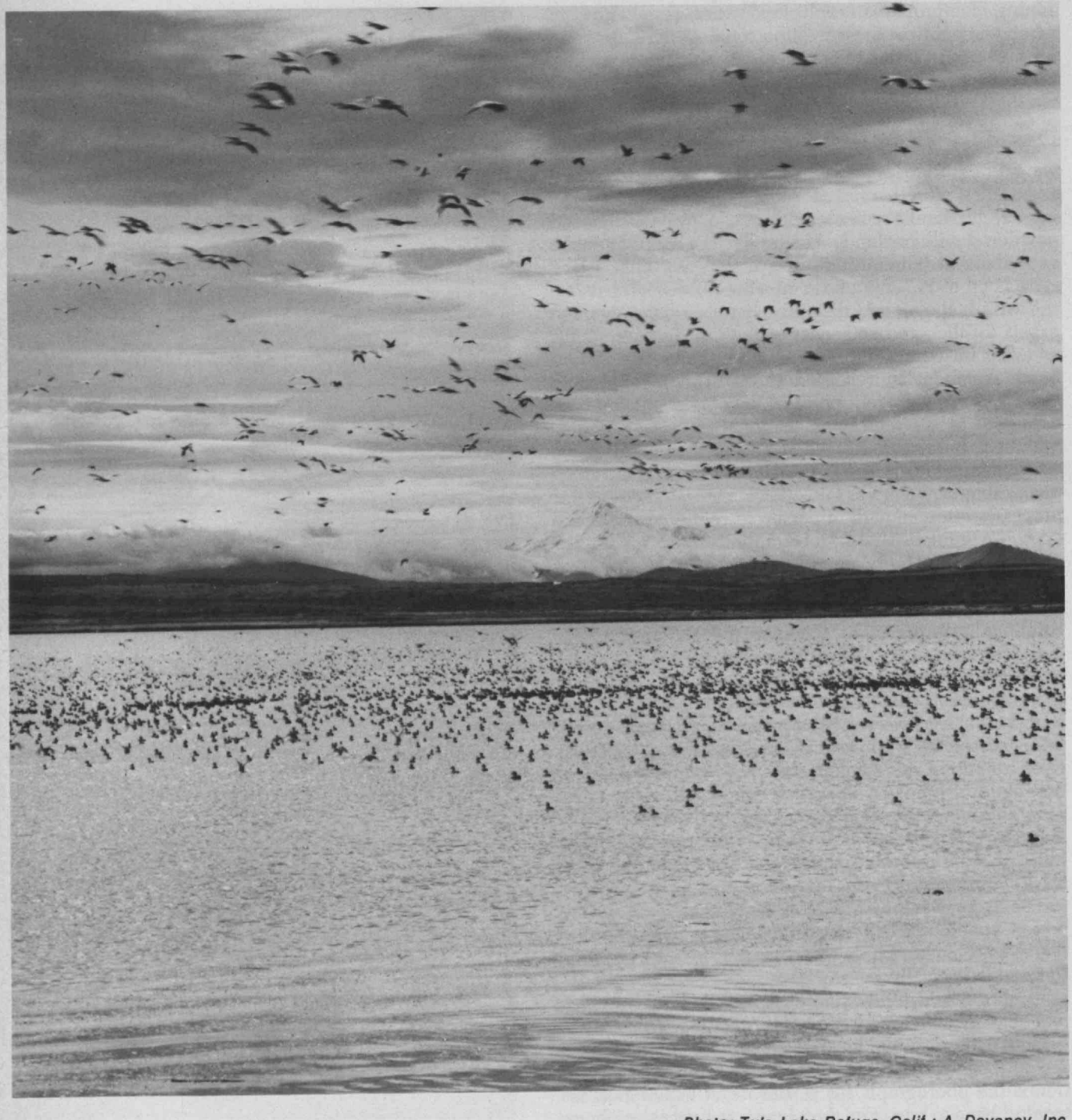


*Photo: Tule Lake Refuge, Calif.; A. Devaney, Inc.*

graph is a substitute for experience, two-dimensional and subtly treacherous. The technical excellence of the wildlife photographs we see in movies and magazines raises the ante. The would-be photographer must concentrate ever more on the process and paraphernalia of photography, ever less on his relationships with nature.

The late Spanish philosopher Jose Ortega y Gasset lucidly described the promise and problem of modern hunting in his book *Meditations on Hunting*. As an honest and natural relationship between man and animals, Gasset said, hunting depends on maintaining the right degree of superiority of hunter over hunted. The predator must be able to capture—but not too easily and not always. The prey must be able to escape—but not too readily and not every time. Every incremental gain man makes in his hunting weaponry (from rifle to off-road vehicle) means that he has increased his superiority because wild game rarely can adapt, behaviorally or genetically, enough to regain its distance. Only the loss of hunting prowess in terms of reading sign, physical stamina, and mental alertness partly redresses the balance. Increasingly, however, we have to consciously refrain from unleashing our full technologic powers lest we destroy, not the prey, but the game.

**On Capturing the Benefits of Technology**

Although this essay cannot pretend to cover the entire field of wildlife-technology relations, it would be grossly unwise to omit all comment on an obvious and important fact: Wildlife and wildlife management can benefit from technology. Potential and in-use applications span the entire gamut from research through consumption, from environmental manipulation to political decision making.

Inventory, monitoring, and certain research activities are benefiting from fast-developing remote sensing techniques coupled with satellite technology. The Earth Resources Technical Satellite, for example, is yielding information which allows regional or continental appraisal of water resources, existing vegetation patterns, snow cover, and major pollution sources—all highly useful in the hands of skilled interpreters able to apply this knowledge in the resource-management process.

More prosaically, vegetation management techniques to increase the population of selected animal species are being developed in conjunction with timber production processes. In the pine country of the South and the Douglas-fir and spruce areas of the Northwest, for example, it is demonstrably possible to produce far more deer and other brush-and-sapling wildlife than occurred historically in those regions. This occurs, of course, at the expense of wildlife species which depend on climax vegetation: there is no free lunch.

A new breed of quantitative ecologists and wildlife managers is busily trying to tap the potential of computers for research and management. Although I do not know the state of the art well, I sense a retrenchment among researchers who now understand how much field work must be done to permit satisfactory ecosystems modeling. Likewise, management people have a healthy respect for the computers' ability to wring the value from quantifiable data, but they also understand the major role unquantified or unquantifiable factors have in resource decisions.

**Technological Shield vs. Natural Reality**

The world of the wildlife manager and other applied ecologists is frightening and challenging—and a maelstrom of change. Rarely in position to make land use decisions ourselves, we are finding our knowledge more in demand by decision-makers. More is asked, in fact, than we can deliver. We also find ourselves with a larger and more varied set of "publics" interested in wildland use and conservation.

Potent new research and management tools are being developed, but it is hard to decide towards what priorities they should be applied. We—and humanity—face some major quantitative shortages of recreation space, harvestible game, and wildlife protein production. In nations as affluent and industrialized as the United States we are concerned with a problem only recently understood by many members of the society—the insidious sacrifice of quality of experience at the hands of heightened quantitative demand. When asked by a landowner, "How much recreational use can my land take?" we must respond with another question: "What kind of recreation experience is being sought?"

Man has always been part of nature. Technological developments have increased those bonds. Now that there are far more humans than could survive in a subsistence economy based strictly on our biologic abilities, humanity depends on an unprecedented scale of natural inputs of energy and materials. That we tend to see the technological shield rather than the natural reality does not lessen this dependence. On the other side of the coin, biotic communities are more thoroughly at our mercy than ever before, a responsibility we assumed unwittingly but one we would shrug off at great peril.

**Suggested Readings**

Odum, Howard, "Energy, Ecology, and Economics," *Ambio*, Vol. 2, No. 6, pp. 220-27; an interesting attempt to diagram and roughly quantify relationships in the modern version of the venerable "food web" idea, the web that includes man and his culture as well as wildlife.

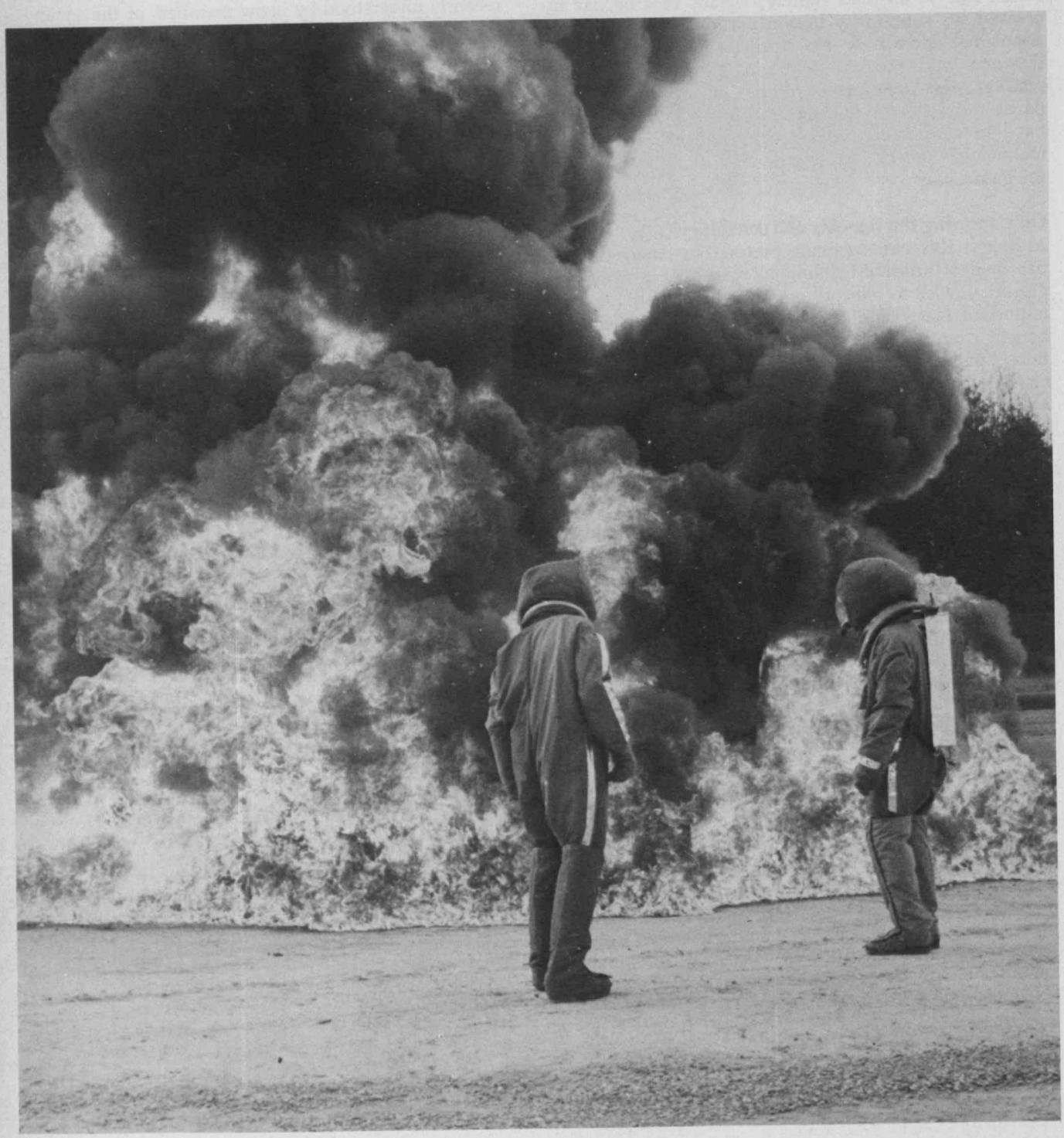
Hendree, John, and Potter, Dale, "Human Behavior and Wildlife Management: Needed Research," *Transactions* of the 36th North American Wildlife and Natural Resources Conference, 1973, pp. 383-96; the problem of defining (and even investigating) human recreation experiences.

Baldwin, Malcolm, "The Offroad Vehicle and Environmental Quality." Washington: The Conservation Foundation, 1970 (52 pp.).

Ortega y Gasset, Jose, *Meditations on Hunting*. New York: Charles Scribner's Sons, 1972 (152 pp.).

**Robert B. Weeden**'s interest in zoology and wildlife took him from New England (he is a native of New Bedford, Mass., and holds degrees from the University of Massachusetts and the University of Maine) to the Pacific Northwest (Ph.D. University of British Columbia, 1959) and finally to Alaska, where he served with the Alaska Department of Fish and Game for a decade following completion of his doctorate. He has been associated with the University of Alaska (Fairbanks) since 1967 and in his present post since 1970. Professor Weeden has published extensively on birds, plants, wildlife management, and conservation in Alaska and the Arctic, and for one year (1969-70) served as Alaska Conservation Representative in a program funded by the Sierra Club, Wilderness Society, and Alaska Conservation Society.

If these fire protection suits seem reminiscent of the space walks, perhaps it is because students from the University of Texas at Arlington were aided by N.A.S.A. in their design. The suits were built for Students Against Fires, this year's Student Competition On Relevant Engineering (*see Special Report, pp. 57-59*). This demonstration proved the suits could withstand temperatures up to 500° F for 15 seconds.



# Trend of Affairs

## Trends This Month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Labor-intensive technology is not necessarily a step to the rear, but patchwork solutions for high technology are the wrong way to go.

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Scientific participation by women can be socialized . . . Western industrialists exploit the third world again . . . Another way to read homicide statistics . . . Would an energy tax punish the poor . . . The black and white of technology, and new opportunities to change the balance.

HEATING AND COOLING 49

The earth grows cooler—and so, too, should nuclear reactors.

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To combat an impending food shortage, grow more of it, spread it around better, and automate the grocers

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S.C.O.R.E. turns the Halls of Ivy into the Firehouse 200


DEVELOPING TECHNOLOGY

## Paint-Roller Technology

Some 20 per cent of the world's population are squatters, living in hovels they have built from whatever they could find on land they do not own. Such "spontaneous housing" surrounds almost every major city in Latin America, Korea, and Viet Nam.

The typical response of an underdeveloped nation seeking to remove this blight on its pride and its people is to turn to high technology—"modern" high-rise public housing structures in the image of Bedford-Stuyvesant and Columbia Point.

The wrong answer, thinks I. Donald Terner, Assistant Professor of City and Regional Planning at M.I.T. Two "fatal flaws," he told a seminar this spring:
—The cost of more than a "token number" of high-technology housing units is simply beyond the capacity of any underdeveloped country; and the cost of enough such units to house one fifth of the world's population is beyond all our wealth combined.
—High-rise, high-technology housing has nothing to do with the life styles to which most ill-housed people are accustomed; for these are mostly farmers, forced by circumstance or the ill-founded lure of urban life into city poverty; their every instinct is to live "close to the earth," thinks Professor Terner.

Instead of "high" technology turn to "low" technology, suggests Professor Terner. Consider, for example, such a simple matter as painting. Professional house-painters used to use brushes; then along came rollers and water-base paints, and all of us could do the job nearly as well as the skilled brush-user. So the professionals' response was to turn to "high" technology—spray machines with which they can paint a five-room apartment in less than an hour.

What the ill-housed Latin American needs is the kind of technology represented in the paint roller: something that helps him do a better job of helping himself. His problem is money, not time, and he needs labor-intensive, low-capital solutions. How about do-it-yourself hoses and connectors for plumbing? Plug-in circuitry for electrical service?

The most persistent dream of low-technology housing advocates is an adult-sized Tinkertoy from which to form the structure of a house; to be successful it must meet three criteria: low cost, low weight, and high performance. So far no one has achieved more than two of these in any design, but "the day it will happen is not far away," thinks Professor Terner.

The problem, he says, is to "by-pass the 'experts,' demystify the building process, and use technology as a true extension of human abilities." To these goals, high-technology products and methods are simply "totally irrelevant."—*J.M.*

## Keeping Them Busy Down on the Farm

What has technology to offer a developing country?

Wealth—and poverty. Jobs—and unemployment. Food—and starvation. Efficiency—and frustration.

No single rule determines which result will be achieved by a nation seeking to develop itself by importing technology; indeed, there may be as many answers as there are nations. Here are a few, from participants in sessions chaired by George Bugliarello (M.I.T. Sc.D.1959), President of the Polytechnic Institute of New York, during the 1974 meeting of the American Association for the Advancement of Science.

It is elementary that a developing country should choose technologies which are labor-intensive, not capital-intensive, in which production can be scaled down without jeopardizing quality. But this oversimplifies the case,

thinks Simon Teitel of the Interamerican Development Bank. Labor-intensive industries bring with them major problems—costly fringe benefits, susceptibility to strikes, problems of layoffs. And consider the secondary effects: a single capital-intensive plant—though itself employing few—may generate employment for many in subsidiary industries. And take a hard look, too—this advice from Charles Bliss and John Reedy of Arthur D. Little, Inc.—at the real cost of labor-intensive vs. capital-intensive solutions in terms of a developing country's national income.

Of all the technologies—chemical, civil, mineral, energy, transport—let developing countries focus on mechanical, says Amir V. Khan of the International Rice Research Institute, Los Banas, the Philippines. Mechanical devices are what he calls "the unorganized sector," easier to understand, most closely tied to basic human necessities, possible of decentralization and great human involvement. Dr. Khan showed pictures of agricultural machines made in small job shops throughout the Far East, of jeep bodies made in local factories, of gasoline engines made with hand-operated machine tools.

But beware of this advice, advocating low-technology, labor intensive alternatives, in the extension of chemical technology to under-developed countries. Smaller chemical plants are almost surely less efficient than big ones. In Mexico, for example, the average chemical plant is one-fifth to one-twentieth the size of U.S. plants producing the same materials, and prices are 20 to 100 per cent higher. But Robert P. Morgan and John P. R. Falconer of Washington University's Center for Development Technology had some suggestions: substitute manual systems for sophisticated remote controls, handle solids as solids instead of fluidizing them, set product quality requirements as low as possible, and look into the history books for discarded chemical processes which may be attractive at small scale.

Having looked with some sophistication at the trade-offs between large- and small-scale industrialization and the secondary effects of these decisions, China has opted to keep its people in the rural setting. Even at some expense of efficiency in production, says Jon Sigurdson of the Royal Swedish Academy of Engineering Sciences, the Chinese Communists have elected to emphasize rural industrial systems, to provide at a local level as much as possible the products needed for local prosperity—simple farm machines, fertilizer, even consumer goods. The result is that 96 per cent of China's farm machinery, 50 per cent of its fertilizer, 80 per cent of its cement come from small plants using labor-intensive methods, a deliberate and apparently successful effort to prevent urban specialization, to capitalize on China's resources of labor, to avoid the dissipation of resources in transportation, and to expose many of China's young people to the issues of technology and industrialization in terms with which they can identify. Mr. Sigurdson thinks such techniques of "rural industrialization" might be relevant for many developing countries; but few of them, he says, seem inclined to eschew the western example by making substantial commitments to localized industry.

Can industrial growth result in more equitable income distribution in a developing country? Perhaps, thinks Irma M. Adelman, Professor of Economics at the University of Maryland—but it doesn't often happen; the usual result is the opposite: industrialization, at least in the early stages, seems to make the poor grow poorer, the rich richer. A different result might be achieved if the developing country firmly resolved to redistribute opportunities and income at the start of the industrialization process—not after its fruits begin to flow to those in the society who were already privileged.

To help sort out all these issues, Dr. Kahn proposes an international industrialization institution. It would help key officers in developing countries discover the industries and programs which will really work, and it would train the entrepreneurs who will run them. Such "full spectrum" assistance is now totally lacking, Dr. Kahn says.—*J.M.*

## Fixes or Repairs?

In trying to control the undesirable side-effects of technology, are we overemphasizing "technological fixes" rather than true solutions? Pierre R. Aigrain, a noted French scientist who is the Henry R. Luce Professor of Environment and Public Policy at M.I.T., thinks that we are. Speaking to an M.I.T. audience last spring, Professor Aigrain described an experience of the French textile industry to illustrate this point.

During the 50s and early 60s, textile factories in France generated a great deal of river pollution using dye dissolved in water to color their fabrics. Unfortunately, much of the dye remained dissolved in the water and was discarded into the river system, dyeing the local river water various colors from day to day.

A number of possible solutions to this problem were considered. One was a process which could partially "depollute" the waste water, removing about two-thirds of the dye. Professor Aigrain considers that this would have been a "technological fix", an imperfect patch on existing technology. Another approach was to distill the water before returning it to the river, but this was too expensive and too wasteful of energy.

Finally a satisfactory solution was found. Instead of water, a mixture of two liquids was used to carry the dye. This mixture was 95 per cent carbon tetrachloride ($C_2C_{14}$), in which the dye did not dissolve, and 5 per cent methanol ($CH_{30}H$) in which the dye did dissolve. During the dying process, the liquid was heated, boiling off the methanol. Since the dye was insoluable in the carbon tetrachloride, it had nowhere to go but onto the fabric. The two liquids could then be collected and reused. This process was totally non-polluting, and also yielded much more consistent and homogeneous hues.

Unfortunately, Professor Aigrain said, a "true solution" of this sort requires a great deal of work to understand the problem thoroughly, and to develop a whole new technology which is inherently less polluting. Such a new technology has the added drawback that it often must be implemented slowly. One may have to wait until existing factories obsolesce, for instance, to replace them with new non-polluting factories.

A technological fix, on the other hand, can usually be implemented rapidly, achieving much more visible relief, but not really solving the problem in the long run. Other examples of technological fixes are pollution control devices on cars or filtering devices on smokestacks.

Professor Aigrain estimated that roughly 90 per cent of research on pollution control concentrates on technological fixes which help contain a problem without eliminating it. The main reason is that these have a much higher short-term payoff. Professor Aigrain proposed that an important part of pollution control lies in developing new and innovative technologies which are inherently non-polluting.—*Perry L. Miller*

SOCIETY

## Women in Science: Start Earlier

Your daughter will be entering high school in the fall. Will you encourage her to take science and math courses as well as English and art? Shop as well as home ec? Her decisions could have significant bearing on her later career choices and opportunities. Indeed, some women have forfeited the chance for careers in science and technology

because of poor curriculum decisions in high school.

To help prevent this kind of error—and in general to encourage women to think of careers in technology and science—is the purpose of a booklet released this spring, "Women in Science and Technology, a Report on an M.I.T. Workshop."

Why do high school girls omit science and technology from their futures? The choice may be the result of little confidence in mathematical or scientific ability, discouragement in those areas by parents or teachers, lack of role models in the scientific world, or simply a lack of knowledge about the career options open to women. "Economic forces, education, family, and other social factors all have an impact on women's perception of career opportunities for themselves and society's utilization of them," the report said.

The fact is that most high school girls with thoughts to the future continue as in the past to see themselves in traditional women's jobs—as teachers, nurses, clerks, and secretaries. When the over-abundance of teachers is compared with the shortages of technicians, doctors, and engineers, it becomes obvious that these girls' career orientations are being channeled in the wrong direction. "This trend is the most disturbing of all our findings," thinks Edith Ruina, who coordinated the workshop and edited the report.

Employer and educator efforts to reverse the trend were the focus of the report, with concentration on how employers and educators might contribute to the long-range problem of a well-prepared work force for an increasingly technological society. For example, employers could loan members of their work force to schools to serve as experts in subject areas and to aid in career guidance.

"The workshop report points out that by now most male employers have been awakened to the problems for women, but the problem is to develop the commitment and strategy for specific actions," said Ms. Ruina.

For employers who want to expand opportunities for women within their organizations:

—Broaden recruitment programs to draw on previously unrecognized sources of female ability.

—Include information on equal employment legislation in orientation programs.

—Provide financial aid for women as well as men in training for technical occupations.

The report suggested some low-cost programs for schools and institutions that could broaden options for young women:

—Form citizen's committees to act as occupational resource centers.

—Curriculum changes could possibly include intervention in the selection of courses at every age and grade level.

—Experiment with methods to attract girls to mathematics, science, shop, and technical courses. Girls could be actively recruited for vocational programs traditionally seen as male.

—Encourage counselors to spend more time on vocational advice.

—Integrate existing courses in shop and home economics so that male and female students are both exposed to the full range of subjects: family management, child rearing, nutrition, consumerism, finance. Such an approach should take account of the technical and scientific dimensions of these issues as well as emphasize the dignity and appropriateness to both sexes of work at home and in the market place.—*S.J.N.*

## Bottled Progress?

To expand their markets in Zambia, Uganda, and other developing nations, at least six baby food manufacturers have been convincing lower class mothers to abandon breast feeding and feed their infants on formula. The doubts arise, though, not in which formula is best for these babies, but whether this is an area where status quo is better than Western technology.

Available information points to the latter, writes Nicholas Wade in *Science* (*April 5, 1974*):

—Malnutrition has begun to appear in babies at the age of eight months rather than the former 18-month average age, pediatricians report. This finding is particularly devastating when considering the close tie between nutrition and brain development at this early age.

—Poorer mothers cannot afford to buy baby formula in sufficient quantities, and often make a habit of over-diluting it with water to make it go farther.

—The water, even when used in the right quantities, is often unclean, so diarrhea is common among bottle-fed infants "to such an extent that their mortality rate is much higher than that of babies that are exclusively breast-fed."

—Human milk contains antibodies that protect the infants from staphylococcal infections and viruses, protection not afforded by formula.

What this adds up to, according to Wade, is "commerciogenic malnutrition," the effects of which should be appalling to the companies fostering the procedure.

Those women who can scrape together the funds for formula have not been difficult to convince. The sociological phenomena of aping the more Westernized upper classes has made breast feeding seem a "vulgar peasant custom." The baby food companies have capitalized on this by sending women, dressed in white "nurse's" uniforms, to sell the products in maternity wards and later door-to-door.


This advertisement has been issued by the government of Zambia to combat commercial publicity promoting bottle feeding of babies among poor mothers.

Finally, the companies are expanding their market as they create it. Lactation, breast feeding, can prevent pregnancy for up to 15 months. Said the report, according to one calculation "prolonged lactation in a highly fertile community could prevent up to 20 per cent of births." Formula feeding, if begun "right from the first week" as one advertisement admonishes, serves the additional purpose of making possible more hungry babies to buy formula for.—*S.J.N.*

## Murder Will Up

"It might seem that the murder rate has been rising since the time Cain slew Abel, but this is not really true." So says Arnold Barnett of the M.I.T. Department of Mathematics, who has been studying the 40-year record of homicide statistics kept by the F.B.I. In fact, the number of murders committed has been rising sharply and steadily only since 1965, and the rate today has more than wiped out the decline that accumulated in the first 30 years of record keeping. Using this type of measurement, Dr. Barnett found "at current murder levels, a typical boy

Four possible projections for future murder rates are: the Pangloss Model, which assumes that the current period of growth is an aberration and that murder rates will return to those of the mid 1950s, the Current Rates Model, which assumes the continuation of present rates through the future, the Saturation Model, which assumes that homicide rates will stabilize at a saturation level about 10 per cent above present levels, and the Linear Growth Model, which projects an annual growth of .4 murders per 100,000 people in the national homicide rate.

The top number for a given city under a given model is the X value: homicide probabilities will be one in X people. The bottom number is the corresponding decline in life expectancy in years because of murder.

These projections were calculated by Arnold Barnett of the M.I.T. Department of Mathematics.

| City | Rank | Pangloss | Current Rates | Saturation | Linear Growth |
|---|---|---|---|---|---|
| Atlanta | 1 | 55 | 28 | 25 | 11 |
| | | .6 | 1.2 | 1.4 | 3.1 |
| Detroit | 2 | 69 | 35 | 32 | 14 |
| | | .5 | 1.0 | 1.1 | 2.5 |
| Cleveland | 3 | 69 | 35 | 32 | 14 |
| | | .5 | 1.0 | 1.1 | 1.4 |
| Newark | 4 | 73 | 37 | 33 | 15 |
| | | .5 | .9 | 1.0 | 2.3 |
| Baltimore | 5 | 74 | 38 | 34 | 15 |
| | | .5 | .9 | 1.0 | 2.3 |
| Washington, D. C. | 6 | 78 | 40 | 36 | 16 |
| | | .5 | .9 | 1.0 | 2.2 |
| St. Louis | 7 | 78 | 40 | 36 | 16 |
| | | .4 | .9 | 1.0 | 2.2 |
| Miami | 8 | 100 | 51 | 46 | 21 |
| | | .4 | .7 | .8 | 1.7 |
| Birmingham | 9 | 101 | 52 | 46 | 21 |
| | | .4 | .7 | .7 | 1.7 |
| Ft. Worth | 10 | 104 | 53 | 47 | 21 |
| | | .3 | .7 | .7 | 1.6 |

born in a large American city in 1974 and living there all his life is more likely to die by murder than an American soldier in World War II was to die in combat." The chances that these reported rates are inaccurate, too, is slim, because murder, being the most foul of crimes, generates the most accurate of statistics.

Public policy has also been slow in reacting to the rising incidence of homicide. Dr. Barnett cited among these reactions the reinstatement of the death penalty in 23 states since 1972, the severe New York drug control laws, and the defensive position of gun control advocates. Reaction would be even stronger, though, if these statistics were available in the more comprehensible form of the quotation—replace murders above per annum per 100,000 citizens, with the probability that a randomly chosen baby born in a given city will die of murder, or the number of years the life expectancy for each child born in a given city will decrease because of murder, for example.

Dr. Bartlett's statistical method was quite simple. For the fifty largest American cities, he took the murder rates of 1971-2 and divided them by the rates of 1963 and 1965—the years the rates began their spectacular upturn. The ratio of the two figures, when adjusted for demographics, was surprisingly uniform, almost to the extent of discounting random variations. Forty of the fifty cities have come within 25 per cent of doubling their murder rates within the last ten years, an incredible agreement when one considers that the comparisons are between such cities as New York and Tucson, or Minneapolis and Detroit.

The causes for the increase are still in doubt. According to one source, the upswing in homicide is due to the products of the baby boom in the 1940s and 1950s reaching adulthood. "Supposedly, the ages between twenty and thirty are more murderous than the ages between eighty and ninety," Dr. Bartlett said. This particular demographic accounts for only ten per cent of the upswing, according to his figures, and does not explain the situation in its entirety.

The lack of certitude in regard to causes leaves plenty of room for predictions. Dr. Bartlett offers four possible futures, and has calculated the two measures mentioned above for each of the four futures for each city. Unfortunately, none of the results are very encouraging. The first model he offers, the "Pangloss" Model, is the most optimistic. This assumes that the murder rates we are now experiencing are an aberration, and murders will fall back to the low rates experienced in the early 1950s. The second, the Current Rates Model, assumes that murder rate statistics will continue at their present values. The Saturation Model, based on recent data, assumes that homicide rates will stabilize at a saturation level about 10 per cent above present levels. The Linear Growth Model, which projects an annual growth of 0.4 murders per 100,000 people, is pessimistic but more conservative than a model based on a fixed percentage growth in the murder rate. "It is interesting that the projected homicide probability in the safest city under the most optimistic model is one in 634," Dr. Bartlett said. More typical of his findings, a baby born in Boston today and continuing to live there faces a one in 71 chance of dying by murder under the saturation model assumptions, and a one in 32 chance under the linear growth assumption.

"One wants to dismiss such results as Cassandra-like ravings, but the facts will not cooperate. The murder rates in some sections of some cities are already very close to the maximum levels predicted in the linear-growth formulation," he continued. "Perhaps the best way to invalidate the grim predictions we have come upon is to invalidate the premise of public inaction on which they were based."

Dr. Bartlett was assisted in his study by Daniel J. Kleitman, Professor of Mathematics at M.I.T., and Richard C. Larson, Associate Professor of Electrical Engineering and Urban Planning at M.I.T.—*S.J.N.*

## Would the Poor Pay More?

One suggested plan to slow ever increasing individual demands for energy in times of shortage is an energy tax—a charge per head per B.t.u. used. But a second look proves this would be, like taxes on food, "probably somewhat regressive."

The second look is provided by R. A. Herendeen of the University of Illinois Center for Advanced Computation. In

a study relating energy consumption to affluence, he learned that direct energy use, a sort of "fixed overhead" consisting in part of home heating and gasoline, is a relatively small proportion of the total energy consumption for which an affluent family can be held responsible. More significant is an affluent family's indirect energy usage—second automobiles, appliances, and air travel on a scale the poor are unable to match.

This could also be read to mean that energy conservation through a tax on direct use or through such measures as better home insulation and car pools would have less effect on the energy impact of the affluent on a percentage basis. "For the highest income class ($20,511/yr. based on 1962 figures), such measures would miss two thirds of the energy impact. For the nation's consumers as a whole, about one half of the energy impact would be missed," said Dr. Herendeen.

Dr. Herendeen's conclusion: A "fair" energy tax would "require detailed knowledge of how industry would pass along increased costs," and must include both direct and indirect energy use.—*S.J.N.*

## Black Technology, and Black Science

In the strictest sense, science and technology transcend the boundaries of race and culture. But in reality, "science and technology have never been without ethical and political implications," thinks Carl Spight, Professor of Physics at Morehouse College. In that sense, there really is black technology and even black science, designed to respond to the real needs of the third world, distinct from the culturally biased science and technology developed by whites for whites.

Consider the example of plastic pipe. Among the critical needs of those who live in dilapidated central-city housing—mostly blacks in many American cities—is technology which would make housing rehabilitation less expensive, more accessible on a "do-it-yourself" basis. Plastic pipe, suitable for permanent installation to carry hot and cold water and waste water alike, is one such technological development, Thomas Atkins, Secretary for Communities and Development of the Commonwealth of Massachusetts, told a conference of black students and alumni at M.I.T. this spring. Its installation is simple enough to be learned and done by many householders, and the material is inexpensive.

So, thinks Mr. Atkins, it is a classic example of black technology: a development with special leverage for problems which blacks bear disproportionately in American society. Typical in another way, too, said Mr. Atkins: a new technology fought by those whose profits depend on more conventional methods—in this case, the plumbers with whom a compromise has only recently been reached.

There are typically these two gaps between technology and blacks' ability to use it, said Mr. Atkins—the simple question of knowing that the technology exists, and then the question of making it accessible; and there is a great unfilled need for people who understand how technology can truly help people and the processes of compromise that are so often involved.

If that is black technology, what of black science? Put yourself in the role of a black southern farmer who walks barefoot leading his cow down a dusty road from village to field each morning and back again each evening. How can he understand electricity and magnetism—the idea that electricity in the armature of a motor can do useful work? "If you take science as taught in our schools to such a person," said Professor Sam Anderson of the College at Old Westbury, New York, "you become instantly an elitist scientist," talking about a tool of whites' oppression of blacks. Indeed, said Professor Anderson, even a black teaching such a subject in this way runs the same risk.

Science itself is objective, a search for truth. In its application, however, said Dr. Anderson, "it can be an oppressor of our people or a liberator. We [black scientists] are the most strategically placed people in the world in regards to how science is used."—*J.M.*

## A Time to Act for Black Engineers

Perhaps for the first time in recent history, only one obstacle stands in the way of broadening the role of blacks in engineering commensurate with their numbers in the nation.

That obstacle is money, says Percy Pierre, Dean of the School of Engineering at Howard University.

Blacks' isolation from science and technology began with their exclusion in the 19th century from labor unions and from industrial employment—and hence their exclusion from experience with many modern machines of production. Four reasons for that exclusion continued in the 1960s, says Dean Pierre:

—Few black colleges could afford the expensive equipment for effective education in science and engineering.

—Blacks, unaware of modern engineering, were in general not interested, and schools pressed to increase black enrollments tended to "steer blacks down the road of least resistance."

—The success of most programs in minority education was measured by the numbers (or perhaps the proportion) of students who graduated. The tendency of advisers responsible for the success of these programs, therefore, was to discourage blacks from such high-risk curricula as science and engineering.

—Many blacks, intrigued by the "help your own" syndrome, went into social work and medicine intending in this way to most benefit other less fortunate of their brothers.

As a result, almost ever since science and technology assumed their present roles in modern society (there is a short, early history of contributions to technology by blacks), blacks have systematically been excluded from science and technology. Even when in the 1960s many careers were reopened to blacks, engineering was not among them.

Things are suddenly different in the U.S. today, and doors through which blacks were formerly discouraged from passing—among them those to engineering—are now open wide. We have finally realized, said Dean Pierre at an M.I.T. Black Students Conference on Science and Technology this spring, that "blacks cannot reach full potential until they have mastered technology," that technical help, for example, is essential to political success today. And the decreasing demand for engineering education among whites leaves empty places in many engineering schools.

Together, these circumstances provide blacks with a unique opportunity to become an integral part of our technological culture," said Dean Pierre. The constraint is money: money to help blacks who come from underprivileged families, money to provide for five or six years of college experience because many of them come from inadequate schools, money to provide special counseling and other services.

That money must come from industry. Indeed, just as the employment of blacks has become a goal for most American companies, the obligation to support education in technology for blacks should now be considered a "cost of doing business"—simply a necessary strategy for developing the talent which industry will need in the decade ahead.—*J.M.*

HEATING AND COOLING

## The Ice Age Cometh

Are man's pollutants changing the world climate? An unanswered ques-

tion, at least until recently—some scientists proposing increasing amounts of carbon dioxide would trap heat within the atmosphere (the "greenhouse effect"), others that particulates in the air would block enough warming sunlight to bring on another ice age.

Now the debate may be over. The earth is cooling off, and at least one climatologist proposes that the by-products of industrialization are speeding the onset of another ice age.

The cooling effects are manifested most dramatically in West Africa and northern India by the failures of the monsoons in recent years.

It is Reid A. Bryson's theory that the changing climate in these regions and in the rest of the world is due largely to the size of the circumpolar vortex. The northern circumpolar vortex is a mass of cold, heavy air that seeps southward from the arctic—a whirling version of the Sherwin Williams Paint trademark that governs the prevailing westerlies of the northern hemisphere. It extends further south in the winter, causing northwesterly winds bring the dry season to India and Africa. In summer it recedes and the subtropical southeasterlies take over, bringing the rain. In recent years the circumpolar vortex has, in effect, ignored summer, remaining in its mid-winter position throughout the year, forcing the monsoons to drop their rain at more southern latitudes.

A partial explanation for the increase of the size of the circumpolar vortex could be man's manipulation of the atmosphere, Dr. Bryson—he is a member of the Institute for Environmental Studies at the University of Wisconsin—told the American Association for the Advancement of Science this winter. "There is growing evidence that the particulate loading of the atmosphere has increased in the last decades, and that the direct beam solar radiation received at the earth surface has decreased," he said.

More ice remains unmelted with less solar radiation reaching the surface, and more ice means increased albedo—reflectivity—making the amount of solar heat that is absorbed decrease even more.

But what of carbon dioxide, supposedly a heat-trapping agent? Dr. Bryson thinks that, while increased amounts of carbon dioxide have perhaps stalled the cooling trend, most of the effect is in warming of the lower regions of the atmosphere. This increases vertical temperature variations, another factor governing wind and water circulation, giving more force to the dry winds that descend to earth when they meet the cold polar air. "This should continue to destabilize the atmosphere and expand the circumpolar vortex," said Dr. Bryson.

**Climatic Overtones**

Polar air and particulate emissions notwithstanding, we really have no workable theory to explain or predict climatic change. "Climate is a highly nonlinear, interactive system that has defied a complete quantitative description," according to William Kellogg and Stephen Schindler of the National Center for Atmospheric Research's Climate Project, also speaking at the A.A.A.S. All we know for sure is that a push in one direction—increased carbon dioxide, for example—will lead to some sort of pull somewhere else.

The suggestion that we may be affecting climate inadvertently leads in their minds to the possibility of climate control. The complexity of the climatic system is "staggering, but not necessarily fatal to the development of a comprehensive climate theory."

Just in case someone does figure out the complex workings of wind, water, and air—not to mention radiation and rotation—Drs. Kellogg and Schindler have a suggestion—"no-fault climate insurance." Since the effects of any type of climate manipulation are bound to be somewhat uncertain, uninsured tampering with "the system that determines the livelihood and life styles of people the world over would be the height of irresponsibility," they said.

Even the matter of climate stabilization is shaky: If means to prevent the Indian and North African disasters were at hand, should we use them if the worldwide effect was uncertain?—*S.J.N.*

## More Core Cooling Than We Knew?

The major debate over whether nuclear power plants should be built is actually a series of controversies nestled one within the other, like a set of Chinese boxes.

The center of the nuclear plant controversy is whether power reactors are safe. The center of the safety controversy is whether the systems specified for each plant will cool the hot, radioactive nuclear core in the unlikely event of an accident. And finally, the center of the emergency core cooling controversy is whether nuclear engineers have adequate understanding of heat transfer and fluid mechanics to predict the heat transfer between the nuclear fuel rods and cooling water during a power plant accident.

Two members of the M.I.T. Mechanical Engineering Department, Professors Peter Griffith and Warren M. Rohsenow, are increasingly satisfied as a result of ongoing studies within this center "Chinese box" that A.E.C. specifications for core cooling systems are more than conservative. The A.E.C. is operating "well within safety limits in all its assumptions," they write.

The research that leads to this conclusion is devoted to measuring the heat transfer coefficients—how well heat naturally flows from metal to coolant for conditions similar to those occurring during the progress of an accident.

The "maximum credible accident" the engineers postulate in conducting their studies consists of a clean break in one of the massive pipes that carries pressurized water into the nuclear core. Such a large break, using present calculation methods, would cause rapid depressurization in the reactor core—called a blowdown—and a rapid rise in core temperature as cooling water escapes. Like water splashed on a hot stove, core water after a blowdown would begin to sizzle into steam without extracting much heat very rapidly from the fuel rods. Also, steam which forms in the super hot inner chamber would be a gas, too dry to cool the hot fuel elements.

To investigate these processes, the engineers have performed several basic heat transfer experiments. Professor Griffith is satisfied as a result of the work that "the period after an accident until the cooling water would cease to function effectively as a coolant is much longer than the Atomic Energy Commission calculates." In other words, he says, "the mixture of water and steam that would occupy the space around the fuel rods after an accident would do a much better job of extracting heat than anyone has supposed."

But the results have also led to a suggestion: "The A.E.C. specifies that an Emergency Core Cooling System must blast emergency cooling water into the core immediately upon the loss of pressure. But at this time cooling water is still flashing into steam and escaping through the broken pipe, and we believe some of the emergency cooling water will tend to be ejected also, without accomplishing much cooling."

A more effective procedure, thinks Professor Griffith, might be to turn on the emergency core cooling system only after blowdown has finished—perhaps as long as 20 sec. after the accident—and then flood the reactor with the emergency coolant.

Experiments with the electrically heated, nitrogen-cooled tube show that the A.E.C. may be much more conservative than it thinks in terms of heat transfer coefficients after the Emergency Core Cooling System has been turned on. According to Professor Rohsenow, their data indicate that "there may be up to five times better heat transfer between the heated fuel rods and the emergency coolant after a blowdown than the A.E.C. allows for."

"If these figures are accurate," he says, "emergency cooling water would do a much better job of cooling than is now calculated. The A.E.C. could then allow reactors to operate at higher powers and therefore less expensively without fear of fuel rods reaching their melting temperatures in the event of an accident."—*Dennis L. Meredith*

FOOD

# The Food Crisis: Take Smaller Bites

Ecologists and economists are somewhat like oil and water. Stir them up, put them under pressure, and you get mayonnaise. For an example, Lester Brown, Senior Fellow at the Overseas Development Council, turned to food: the pressure of growing demand is "ecologically undermining some important food producing systems," he said.

For example, the anchovy fisheries off the west coast of South America accounted for a fifth of the world fish catch until a few years ago. Then the anchovies inexplicably wandered away. A drop in ocean temperature and a meandering of the Humboldt Current, neither unprecedented, were given as explanation. But the huge schools have not yet returned in full force after almost two years, and the likely cause now seems to be overfishing. "No one knows how long it will take for them to recover," said Mr. Brown. "Whether it's a few years or a few decades, we just don't have any history by which to assess that."

The drought along the southern fringe of the Sahara is another case cited by Dr. Brown at an M.I.T. seminar early this year. As people move south to avoid the drought, they bring with them increased pressures of human and livestock populations with accompanying overgrazing, deforestation, and denudation. The result is that the desert itself is pushed southward up to 30 miles a year. Then still more people are forced to flight, and the ecological pressure becomes even more intense.

These economic changes, and their ecological reverberations, are not peaks of a cycle but forecasters of a fundamental change in the structure of the world food economy, according to Dr. Brown. Demand will not decrease but multiply, due to rapidly growing population, and due also in part to man's expanding preference for meat, in the image of America, a habit that uses four times more grain per capita per year than simpler diets.

Planning is needed. We no longer have enough resources to waste good farmland on superhighways, suburban developments, and shopping centers. Schemes to make rain in one drought area must be tempered by the realization that rain which falls in one place won't fall in another—and Dr. Brown can envision a sort of "meteorological warfare" over supplies of fresh water for crops. Energy shortages are leading to fertilizer shortages and possibly to a cycle that will cut foreign crop yields regardless of this summer's weather.

Three policies will help avoid the food crisis:

—All cultivated land must be made to produce its full potential, requiring a full commitment of technology and resources. India, with the same area under cultivation as the U.S., produces only two-fifths the grain. Since those lands have the equivalent soil and water potential, India is a resource that could be developed.

—An international food reserve should be created. Food reserves on a worldwide level are now down to a 29-day supply, the lowest since 1965; the world depends too heavily on the U.S. and Canada to intervene in case of famine, and one bad summer in North America could be disastrous.

—Population growth must be curbed, and the diets of affluent countries, such as the U.S., must be simplified to make most efficient use of the food that is available—*S.J.N.*

# Thought for Food

Last year food prices increased 22 per cent, and the Department of Agriculture's estimate of a 12 per cent increase this year is hopefully conservative at best. Although supermarkets will show some improvement in profits this year, they are not cashing in on much of the price increase, and with profits averaging one half of one per cent of sales last year, many large chains are going "weeeo" themselves.

Why the explosion in food prices? There are many reasons, but according to Gordon F. Bloom, coordinator of the Technology Applied to the Food Industry Project (T.A.F.I.) at M.I.T., a major one is the snail's pace of technological progress in the retail food distribution system. True to its name, T.A.F.I. is trying to pull new technology through the food industry—an industry which has not changed its basic form of operation in the past 30 years.

One of the major technological developments being reviewed by T.A.F.I. is the automatic checkout. In full operation, this system could save supermarkets as much as one per cent of total sales. Most cans and packages would be marked by producers with a 10-digit universal code. At the checkout, merchandise would be exposed to a scanner, enabling a computer to recognize the product and to convey to an electronic register the proper price of that item as contained in the computer's memory. The system would eliminate the need for store stamping of prices on individual cans and packages and, of course, would also eliminate the need for changing prices on items already on store shelves, a process which has been especially expensive in this year of erratic price increases. Information in the computer would for the first time provide up-to-date information on items sold each day and would make possible automatic ordering and better inventory management. According to Donald Stowbridge, Vice President of Stop & Shop, Inc., the system should be in operation by this time next year.

Some bugs remain to be worked out, though. Individual prices would not appear on the separate items, though prices would be shown on gondola markers on shelves above individual items. However, the industry faces a problem in keeping such price markers continuously up-to-date, and furthermore many consumers find the lettering difficult to read. Unit pricing adds to the confusion. The electronic register will give the shopper a complete printout of her purchase showing the item and its price, but this may not satisfy today's consumer. This is a problem which must be resolved before the new computerized system is accepted.

T.A.F.I. brainstorming, which includes offerings from supermarket personnel, engineers, operations executives, and consumers, has resulted in other suggested ways to update supermarkets:

—an automatic bagging system that would save both the time and labor expense now required in bagging.

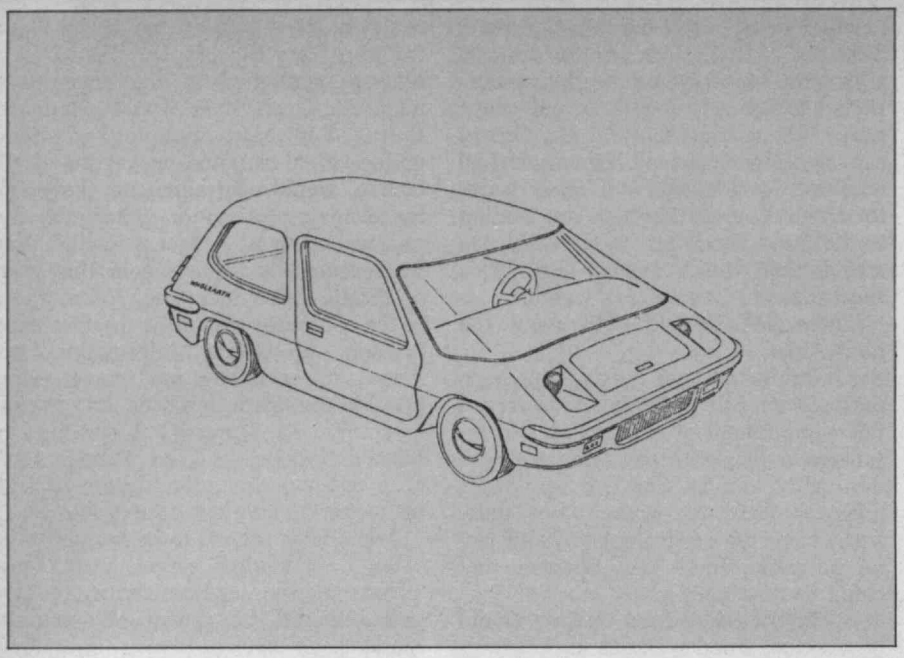
—self-cleaning dairy cases, which would save on electric bills and labor.

—a de-boning machine, to prevent wastage in butchering.

—automatic stocking shelves, to save the nickel it costs per case to put the items on the shelves.

—magnetic tapes on items, to be read by scanning devices, to reduce the half of a per cent of sales lost annually in rip-offs.

T.A.F.I. is planning workshops this summer, getting supermarket executives together with engineers to try and make some of the above ideas reality. For a hundred billion dollar industry which has never marked funds for research and is feeling the effects, it is about time.—*S.J.N.*



Alumni attending a day-long seminar on "automobility" at M.I.T. in June received a unique handbill from Professor E. Eugene Larrabee and five undergraduates in the Department of Aeronautics and Astronautics: a brief technical paper describing their design of the "Wholearth Car"—"a personal transportation vehicle adapted to the needs and constraints of a steady-state industrial society which may exist about A.D. 2001. It is intended to carry a steady-state family composed of two parents and two to three children in reasonable comfort at speeds of 100 km./hr. to destinations not easily reached by common carriers. It would use little fuel, conserve mineral resources, and have a benign ecological impact . . . A design philosophy of durability and refurbishment . . . is favored over a philosophy of unlimited production, short life, and replacement." (Drawing: Gordon O. Salmela, M.I.T.'74).

TRANSPORTATION

# How Can Cars Be Compatible?

The automobile is here to stay. Even the staunchest advocates of mass transit, clear air, and rational cities admit it.

But the automobile of the future need not be like that of today, and the differences will make tomorrow's car a better citizen than today's, a more nearly integral part of a more rational, mature transport system.

Eleven transportation experts assembled for a major seminar on "Automobility" on M.I.T.'s Alumni Day this June. Some judgments were concealed in a mist not unlike the smog which occasionally envelopes today's auto-dependent world; others were obvious:

—Cars will be smaller. By 1976 gasoline will likely cost 60 to 68 cents/gal., thinks Morris Adelman, Professor of Economics at M.I.T.—a 40 per cent increase over 1969 prices, but not enough to bring about more than minor changes in Americans' life styles. We'll still live in the suburbs, drive to Grandmother's for Sunday dinner, and take the kids to the beach. But we'll do all these things in smaller, more economical cars—and for some parts of the system—the automakers, for example—this will be (already is) a matter requiring major adjustments.

—Cars will be safer. Dr. William Haddon, Jr., President of the Insurance Institute for Highway Safety, proposes that today's system of highways and motor vehicles represents "a failure of monumentally tragic proportions"—13,000 casualties a day, a total of 2 million auto-related deaths in U. S. history. No half-measures—safety devices, speed limits, highway redesigns—will suffice to correct that failure, and no reliance on consumers' tastes and presumed good judgment. Dr. Haddon's prescription is utterly simple and forthright: he mandates "a mix of strategies and tactics, chosen . . . for their contributions to reducing the social problem—the damage to people and property . . . ."

—Cars will be cleaner. Despite the advocates of more radical solutions, John B. Heywood, Associate Professor of Mechanical Engineering, puts his money on the internal combustion engine. Within that category are a wide range of options for meeting clean air standards—catalyst systems for cleaning exhaust gas, rotary engines, stratified-charge engines, diesel engines—and of these Professor Heywood picks the stratified-charge configuration as the dominant form by the 1980's. Meanwhile, the automobile owner is in for a period of muddling through, thinks Professor Heywood.

"We tend to be too simple-minded about new technology," he told the Alumni Day audience, because we forget that the automobile industry is "enormous in scale and evolutionary in process." For example, said Fred W. Bowditch, Executive Assistant to the Vice President—Environmental activities at General Motors, design of a new engine for Chevrolet's Vega began five years before the first product reached the marketplace in 1973.

Though "new technology has a lot to offer" (Professor Heywood's assurance), the automobile industry is "more caught up in constraints than any other sector of the economy," thinks Henry D. Jacoby, Professor of Management at M.I.T. For example, its technology and its structure are "woefully inadequate" for achievement of the mandates of the Clean Air Act. The result is a series of crash programs to meet too-short deadlines which are postponed one year at a time—a situation which makes necessary conservative, short-range tactics in place of the long-range program which might eventually yield better alternatives at lower cost.

It's a classic case of the general problem of regulating technology, thinks Professor Jacoby, and he offered two suggestions:

1. Beware of the "ultimate threat" approach and the "hydrogen bomb" solution. Look for more gradual change, and take time to assay the affects of a solution before it is adopted.
2. Find better ways of making marketplace incentives work toward social good. (A long argument at the end of the day resulted when James W. Ford, Assistant Comptroller of Ford Motor Co., emphasized his industry's responsiveness to the marketplace—and was challenged by alumni who proclaimed the disvalue of research and development that concentrated on "style, color, and fittings" and that "has nothing at all to do with real research and development objectives.")

Professor David G. Wilson of the M.I.T. Department of Mechanical Engineering likes "marketplace" solutions, too. If we are to make our use of automobiles more rational, let negative feedback work for us by making costs increase as use increases, he said; let the beneficiary of an automobile—its owner and its passengers—pay the full costs of the services they enjoy.

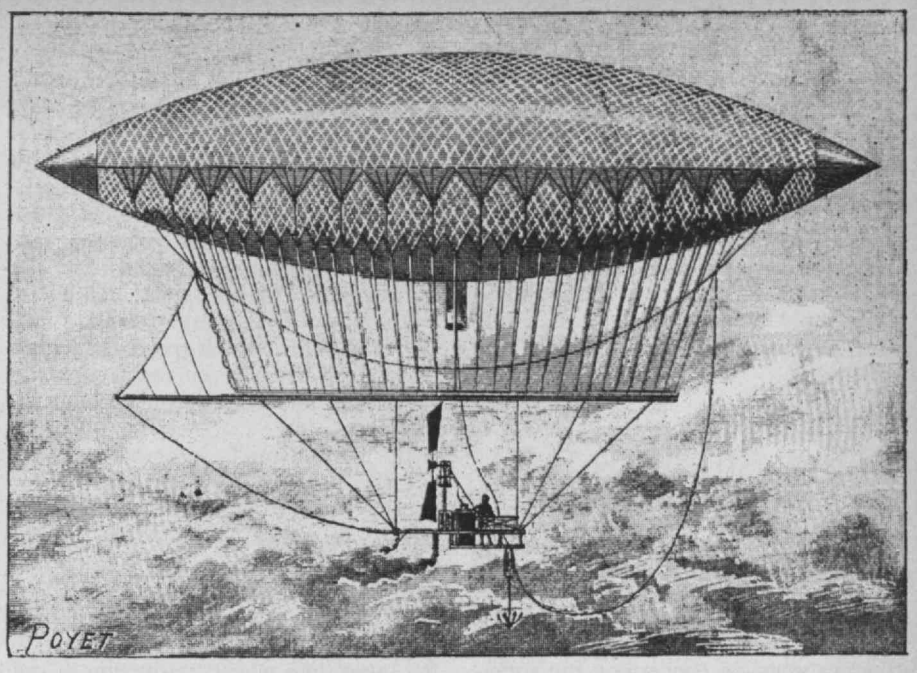
It doesn't work that way now, thinks Professor Wilson. He regards automotive transportation today as "grossly underpriced," which means that some of the costs of automobile users are paid for by non-users. He

thinks each of us would use his automobile more rationally if we knew its real cost—and paid it.

Would this really resolve the paradox which disturbs Alan A. Altshuler, Massachusetts Secretary of Transportation who is on leave from his M.I.T. post as Professor of Political Science? True, there is a public clamor for more mass transit, fewer highways. But the public is still acting very differently in private, he said—buying more automobiles, letting public transit run half full, using airlines more and railroads less. When the chips are down in the ballot box this fall, Professor Altshuler wonders, will Massachusetts voters really open the state's highway trust funds to mass transit use?

If he sounded pessimistic, he was not; he was simply, Professor Altshuler said, making clear the complex dynamics of the search for a new, mature phase of transport development. But the trends are clear: There will be increasing emphasis on service achieved by new adaptations of very conventional technology ("The political system is highly suspicious of high-technology solutions," he said), and there will be "overwhelming pressure to control costs and environmental and community impacts." Those are the attributes of the more rational system of the future, in which public preference assures the automobile a place.

The same idea from Daniel Roos, Associate Professor of Civil Engineering at M.I.T. All the grants of the Department of Transportation for new transit equipment notwithstanding, the patronage of mass transit has not substantially changed in the U. S. Especially in an era of affluence, he said, it is easy to add equipment but hard to make the system changes that will really make mass transit serve more people better in the long haul. —*J.M.*




Can the dirigible make a come-back as a cargo carrier? One of the first optimists was Henri Giffard, whose first hot-air dirigible flew (above) on September 24, 1852. That was 120 years ago, but the question is still unresolved. So the M.I.T. Flight Transportation Laboratory will sponsor a "Lighter-Than-Air Workshop" at the Naval Postgraduate School in Monterey, Calif., at the end of the summer. The goal, says Joseph F. Vittek, Jr., of the Laboratory, "is to establish what facts are known about lighter-than-air's potential, what are the unknowns, and what are programs that could answer some of the unknowns." (Photo: Bettman Archive)

# Dirigibles: Think of Elderly Windbags

More than nostalgia stands behind the idea of lighter-than-air vehicles to help solve the nation's transportation/energy problems. But not much more, according to a panel of experts assembled by the American Institute of Aeronautics and Astronautics during its annual meeting in Washington this winter. Indeed, the final verdict of a penal on "The Helium Horse: Air Transportation for Tomorrow?" was a heavy dose of cold water.

J. Gordon Vaeth of N.O.A.A.'s National Environmental Satellite Service is an enthusiast. One plan for N.A.S.A.'s space shuttle, he said: Give it a head start on its trip to space by launching it from beneath a dirigible—literally, a floating ligher-than-air launchpad.

The Soviets, he said, have been looking at designs for a nuclear-propelled dirigible which might carry 1,800 passengers at 180 m.p.h. He and Professor Francis Morse of Boston University have more modest visions: freight-carrying dirigibles to do the work of scores of freighter aircraft, and smaller rigid or nonrigid ("blimp") airships for cleaning up oil slicks, bringing rescue and relief in natural disasters, and other missions where a floating, stable platform is needed. (Stable? That depends on wind and weather, said someone in the audience.)

Don't judge the airship of tomorrow by those of the past—the Graf Zeppelin and the Hindenburg, for instance, said Kurt R. Stehling, Science and Technology Adviser to N.O.A.A. New structures would be simple: a single skin of thin, stressed alloy or composite, not a complex of airbags in a metal girderwork covered by fabric. And consider the special advantage of nuclear power: as a conventional engine uses fuel the airship it powers becomes progressively lighter—a neat challenge for ballast and control systems. Not so with nuclear power; the fuel reservoir changes weight hardly at all.

A pro-dirigible bloc in Congress? There is none, said Charles F. Lombard, a member of the staff of the Senate Committee on Aeronautical and Space Sciences; the dirigible is simply a vehicle whose time isn't now. The dirigible has friends in the Department of Defense—but not many. Its role as a radar platform for the antisubmarine service in World War II will never be repeated: technology has changed, and aircraft can now do that job better, said Rear Admiral Carl J. Seiberlich, Director of Aviation Programs in the Office of Chief of Naval Operations.

How do you move a nuclear reactor 22 ft. in diameter, 67 ft. long, and 820 tons heavy? By barge, if the destination is near navigable water. But if it's not, will the dirigible capture that market? Stephen J. Keating, Jr., of Combustion Engineering's Nuclear Power Department is skeptical. Three problems: the concentrated load (820 tons hanging from a harness of cables), control (when you drop the 820-ton load, what do you do for ballast?), and stability in wind and storm.

More cold water from Gerald G.

Kayten of N.A.S.A.'s Office of Aeronautical and Space Technology: a vehicle to carry 2 million lbs. of cargo would have 20 acres of skin, and nothing short of "universal conscription" would yield a ground crew big enough to handle it. Still more from Abraham Hyatt of Rockwell International: "Each time in history when one means of transport displaces another, it offers some unique, special capability. You simply cannot point to such a feature in the lighter-than-air ship," he said.—*J.M.*

## Clime Study: S.S.T. O.K. with Controls

After doling out nearly all of the $20 million authorized for its Climatic Impact Assessment Program (C.I.A.P.), the Department of Transportation's motivating question concerning the supersonic transport has changed from "Dare we fly it?" to "What restrictions should be tied to its flight?"

In generating a lot of original data on critical trace constituents of the stratosphere and on possible climatic, biological, and economic effects resulting from contamination of the stratosphere by the S.S.T., the C.I.A.P. study has erased water vapor as a significant problem. The main problem seems to remain the nitrogen oxides, their effect on ozone levels, and the biological effects of any resultant increase in ultraviolet radiation reaching the ground.

At the Third C.I.A.P. Conference in Cambridge, late last winter, several papers from France, Canada, and the U.S. reported that natural nitrogen oxide levels in the stratosphere—as measured from supersonic and other high-flying aircraft—were only about half of the hypothesized level. Whether this means S.S.T. emissions of nitric oxides will take a greater proportion of ozone out of the stratosphere than expected is being investigated by Harold S. Johnston, University of California, Berkeley, chemist, one of the first, most persistent, and most controversial workers in the $NO_x$ problem.

Assuming important ozone changes in the stratosphere and subsequent increases in ultraviolet penetration, what kinds of biological and economic effects might be expected? This question also has no cut-and-dried answers, but the C.I.A.P. conference revealed, for the first time, some interesting possibilities. John Calkins at the University of Kentucky demonstrated that simulated solar ultraviolet light, especially at the shorter wavelengths around 300 nanometers, killed large aquatic microorganisms in a matter of minutes. He thought an increase in natural solar ultraviolet could modify fresh-water ecological systems and reduce the efficiency of natural water purification.

A group at Utah State University found the growth of greenhouse plants inhibited by supplemental ultraviolet radiation, while plants in the field were not so affected. Yet, under field conditions, some subtle physiological processes were altered—the mutation rate of stamen hairs on spiderwort and the ultrastructure of soy bean chloroplast membranes. To the Utah scientists, the key question is: which species of higher plants can tolerate or repair damage caused by above-normal ultraviolet radiation levels?

In an overall progress report, C.I.A.P. Program Manager Alan J. Grobecker pointed out that a 1°C. decrease in mean temperature would cause a large reduction in Canadian and Soviet wheat production and Chinese and Korean rice production, all of which are in marginal areas. At the same time wheat production in the U.S. might rise a little.

Frederick W. Bell of Florida State University estimated losses in living marine resources on the basis of projected supersonic air travel. Between 1974 and 2025, he calculated, the losses in commercial and recreational fishing might conservatively be $93 billion (at a discount rate of 3 per cent), most of it coming after 1990.

All of the data at the conference were presented in parametric form, allowing variations in each effect to be related to variations in its immediate cause. This, said Dr. Grobecker, is intended to permit assessments of the consequences of alternative aircraft designs and operations. Such an engineering approach, he said, can provide a basis for prudent regulatory action by the community of nations. The S.S.T. problem is indeed a global one, affecting even off-route nations, for, as a French balloon study showed, it takes only 12 days for stratospheric winds to carry the emissions around the world.—*R.S.*

## . . . and Some Work on Engine Emission

Since the American supersonic transport is a dodo, the British-French Concorde may turn into an ostrich, and the Soviet Tupolev-144 will be limited in numbers, why has the Department of Transportation just spent $20 million to find out if our sky is safe with S.S.T.'s in it?

"An ounce of prevention is cheap insurance," said Robert H. Cannon, Jr., Assistant Secretary of Transportation for Advanced Systems Development and Technology. "Tens of aircraft are no problem, but hundreds or a thousand using today's engine are. We want to be prepared in case they do fly."

Dr. Cannon, who studied and taught at M.I.T., also told a press group at the Third Climatic Impact Assessment Program Conference (C.I.A.P.) in Cambridge last winter that he expects the Concorde ultimately to be successful and that the U.S. will be in the competition with a second-generation S.S.T. His time frame was 10 to 20 years.

If a thousand supersonic transports is to be our fate, what are we going to do about regulating them? The formula for establishing a tolerable fleet size at any given time, C.I.A.P. Program Manager Alan J. Grobecker told the conference, would require that the climatic impact of the engine emissions lay below the threshold of detection. He feels that such a formula would encourage engine improvements as the fleet grows, provide monitoring systems capable of catching errors in theoretical projections, and avoid arbitrary prohibition of stratospheric flight.

The legal basis for regulation of civil stratospheric flight is recognized in the principle of national sovereignty allowing regulation of S.S.T.s by each nation in its own air space and in the authority of the International Civil Aviation Organization, an effective agency whose procedures are accepted and largely adhered to by its 128 national members.

With the final C.I.A.P. report—to be completed by the end of this year—accompanied by Soviet, British, French, and other national climatic impact studies, the nations of the world will have enough scientific and technological data on which to base regulatory decisions, said Dr. Grobecker. They can be made in 1975, he suggested, and in 1985, there can be another evaluation, on the basis of 10 years of monitoring and analysis.

All of this hinges on the ability of the aircraft industry to improve engine emission performance. The two pollutants of concern, nitrogen oxides and sulfur oxides, can be engineered down to acceptable levels, according to Dr. Grobecker.

The emission index of nitrogen oxide is a function of the peak temperature in the engine combustor. Most of today's jet engines operate at above 2500°K. By careful control of the combustor process, said the C.I.A.P. manager, operating temperatures can be brought below 1800°K., at which nitrogen oxides are much diminished with little effect on overall turbine efficiency.

$SO_2$ emissions, he pointed out, can be reduced 20-fold simply by reducing the sulfur content of the jet fuel, at a cost of a few cents per barrel.—*R.S.*

Special Report
Sara Jane Neustadtl
Assistant Editor

# How Students Tackled America's Forgotten Problem


**Student Competitions On Relevant Engineering brings 200 engineering students together to find new methods of fire prevention and control.**

Over 800 people died in the largest fire disaster in United States history, caught unawares by a forest fire that raged over northeastern Wisconsin. Ironically, history disregarded the holocaust and its overwhelming consequences—distracted by Mrs. O'Leary's cow who kicked over her famous lantern in Chicago on the same day.

The inhabitants of Marinette, Wisconsin, though, are very much aware of the blaze that wiped out the neighboring town of Peshtigo over 100 years ago. The Ansul Co.'s Fire Technology Center, located in Marinette, fuels their awareness with modern relevance. Summer in Marinette finds black smoke billowing again over the countryside as Ansul fire training teams light and relight fires, teaching others to control and extinguish them.

This year 200 students from 27 colleges and universities gathered in Marinette to fight fires and public apathy about one of the nation's major hazards. It was the second running of Student Competitions On Relevant Engineering (SCORE). This year's program: Students Against Fires.

SCORE, Inc. grew from the success of the 1970 Clean Air Car Race—a coast-to-coast race of non-polluting vehicles developed by schools throughout the U.S. and Canada. SCORE sponsored the national Urban Vehicle Design Competition (*see Technology Review, Oct., 1972, p. 43*) in 1972. In an area where technology can bring direct benefit to society, SCORE aims to stimulate a project-oriented approach to engineering education, provide new solutions to engineering problems, and bring national recognition to the problems attacked by the competition.

SCORE's first competition choice—automotive design and pollution—was as obvious in 1972 as is energy, the selection for next year. The fire danger is less celebrated, chosen on the basis of some very important but little publicized facts.

The annual cost of fire in the United States is $11 billion. Twelve thousand people die yearly in fires, and injuries number 300,000, with many of the victims experiencing permanent physical and psychological scars. This country, the most technologically sophisticated in the world, has the highest per capita loss from fire of all the industrialized nations.

"The dollar loss from fires is equivalent to the loss each year by crime. And more people are killed by fire than by homicide. The public classifies fires with earthquakes and other 'acts of God' ", says Richard Bland, Chairman of the National Commission of Fire Prevention and Control, who was on hand as S.A.F. adviser and judge. "We know something can be done."

**Hot Time in the Old Town**

The S.A.F. entrants started doing their part 24 months ago, when the competition topic was announced. Unlike the urban car contest, there were no set standards to match and no obvious design problems to rework. The task: to design a relevant, technologically sound, cost-effective, and demonstrable entry in the area of fire detection, prevention, rescue, or control. The students' sources of information: local fire fighters, fire equipment manufacturers, and *America Burning*, the report of Mr. Bland's National Commission on Fire Prevention and Control, a book whose grim statistics provide an insight to the enormity of the fire problem.

Such flexible instructions generated a varied collection of entries, each group choosing a familiar subject under the broad category of fires. The University of Kentucky built a remote-controlled robot for fighting mine fires. A hot-spot detector, used to find smouldering pockets following forest fires was designed by the Washington State team, and a fireproof turnout coat was the offering of textile engineers from Georgia Tech. Relevance, it seems, is where you find it.

Most entrants made their May deadline in Marinette, flying or driving cross-country in vehicles they had designed—a couple of minifire trucks and

A firefighter cannot always be expected to observe every precaution—his work takes him into heat, smoke, darkness, and leaves him exposed to the elements. His turnout coat must protect him under all these conditions.

The majority of turnout coats in use today consist of either a standard canvas or a plastic-coated nylon fabric outer layer with an inside thermal insulating layer. These coats provide little protection from radiative heat, are bulky and inflexible, hamper the firefighter's movements, and add to his physical exhaustion.

Students from Georgia Tech here demonstrate a coat which they feel is "a protective shield in which the fireman can perform his duties—one designed specifically for firemen." They believe the design is more practical than those currently on the market.

The outer layer is made of flame-retardant and water-resistant Nomex, lighter and more flexible than cotton. A metallic reflective layer reduces the effect of heat exposure, allowing the fireman to withstand a great heat flux for longer periods of time. A Nomex fabric provides thermal insulation—protection from conductive heat transfer. Improved design increases ventilation and comfort. Stick-tight fasteners have replaced the conventional metal fasteners, a source of burns and snags for the firefighter. Protective padding reduces injuries due to falling objects. The weight of the whole coat is greatly decreased by the use of synthetic materials.

one fireproof Vega. To some team members, the trip was a rest before finals or graduation. Other teams kept working, like the University of Texas at Arlington team, who brought a head-to-toe firefighter's suit—an S.A.F. coordinator had to show them how to sew it together. Two hundred engineering students, mostly men, congregated there in a town with plenty of pretty scenery, 94 bars, and Ansul.

**The Preliminary Heat**

Oral presentations before a group of knowledgeable judges, punctuated by some stammerings and misplaced slides, opened the competition. But if a few of the presentations were less than professional, no such drawback hampered the judging staff; in addition to Mr. Bland there were the N.A.S.A. Chief of Crew Equipment, the Fire Detection Division head of the National Bureau of Standards, and the Assistant Chief of the New York City Fire Department, Francis Cruthers.

I'm here because it's vital that universities develop fire protection courses," explained Chief Cruthers. "Most people are just not aware of the range of technology necessary to manage a large fire department."

In addition to the needs of big city fire departments, a wider range of technology is needed in other areas as well:

—Firefighters have a death and injury rate higher than any other profession, 15 per cent higher than mining, the next most hazardous job. This may be partly due to lack of training, but obsolete equipment must take some of the blame. The commonly used cloth-and-rubber turnout coat, for example, does not even meet the flammability standards set for children's sleepwear, and firemen are often burned by the heat-conducing metal clasps on their coats.

—Some basic characteristics of fire have undergone little research, leaving decisions such as when to open the top of a building to minimize fire spread a matter of guesswork and experience.

—New high-rise office and apartment buildings have been built with insufficient sprinkler and escape systems; often there is no way to escape from an upper story except by jumping, even with firefighters on hand.

—New materials have made the hazards from smoke and toxic gases an immediate danger both to firemen and to those trapped in burning buildings.

—City traffic can delay firefighters long enough for a minor fire to become a major catastrophe.

—No means of detecting arsonists or those turning in false alarms have been found. Last year in New York City firemen answered 200,000 calls—half of them false alarms.

—Detailed statistics on fires and losses in this country are unavailable. If a five per cent decrease in fires was achieved today, it would go unnoticed.

The list goes on. And as much as new technology is needed, it will not be enough. "The problem is 75 per cent people," according to Mr. Bland. He is afraid that advanced technological solutions will be seen by federal, state, and local governments as a panacea.

"Let me give you deaths in mattress fires as an example," Mr. Bland continued. "We have mattress flammability standards, but many of these deaths occur in poor parts of the country where people can't afford new mattresses. It will take 30 years for this law to be effective. And to replace them all . . . can anyone measure the cost effectiveness of mattresses?"

With this kind of background, the judges were more thorough than some students wished. Their questions to the University of Wisconsin team, who developed a cable system to lower a person slowly from a burning high-rise: "What would happen if it breaks?" "The worst you could do is break a leg." "Can it be returned for more people?" "No . . ."

The University of Houston team also developed a high-rise escape system whose operational safety was severely scrutinized. Their spokesman had just been released from a hospital after he broke his neck testing a poorly mounted escape chute. The question to them: "Can it be mounted safely?"

One of the SCORE requirements was that student's designs be demonstrable, and it was here in the final test phase that the amount of work and ingenuity in the projects finally became clear. A winning example was the University of Houston's fire-safe gas tank—an automobile gas tank that releases a chemical extinguishant upon impact and contact with heat. Feeling overshadowed by the University of California (Berkeley)'s shiny, fire-safe Vega, complete with extinguishers and redesigned fuel storage system, the Houston students jury-rigged a vehicle for their gas tank on the best thing they could find on such short notice—a little red wagon. Berkeley was unwilling to demonstrate, as any effective demonstration would damage their brand new vehicle. The wagon, on the other hand, was expendable—points, said the judges, for Houston.

**Trial by Fire**

Even such ingenuity as the University of Florida's self-extinguishing match could not compete with the crowd-pleasing fire spectacular created by Ansul for the tests. The larger student entries—the fire truck in miniature, the converted pick-up-to-fire truck, and the mine-fire robot—was enough incentive for Ansul's careful pyromanipulatiacs to put on their circus. With the crowd pleasers came the media, represented by a dozen magazine and television correspondents, complete with six sets of crew and camera equipment.

Iowa State, whose Fire Cat was equipped to quench gigantic fires with its two-hose, 500 gal./min. spray off a one-man trolley, had provided their team with identical orange uniforms—a must for color TV. They put out the same fire five times for the sake of the cameras, even before their judging was scheduled.

At a small, two-story building by the side of the test field, students from Clarkson College aimed their rescue

cannon at a target set up on the roof of the building. Their shotgun-like device shoots breathing equipment, protective clothing, and rope ladders through upper-story windows to persons trapped in burning buildings. The reinforced capsule containing the equipment is strong enough to break through glass, a must for modern buildings with sealed windows.

The head-to-toe protective gear developed by the University of Texas at Arlington is reminiscent of the space walks—the helmet and material were both from N.A.S.A.-sponsored designs. A back-pack contains the life-support gear—a tank of liquid air for breathing and cooling. During their relatively simple test, a walk close to a 1600° gasoline fire, the suit started to smoke. "That's just the starch burning off," explained one team member.

Not all entries were tested by fire. Purdue's demonstration required only water and hoses. To free the pump operator who must stay at the fire truck and watch dials showing the water flow through the hoses, the Purdue team demonstrated a pumper truck with computer to automatically calculate and set the appropriate pressure for each hose and nozzle.

Penn State designed and built a two-man fire truck which, according to statistics provided by the Lancaster, Penn., Fire Department, could handle 83 per cent of all Lancaster's fires. The vehicle has its own 130 gal. water tank, pump and hose system, and hand extinguishers. The truck worked perfectly, but a test on a similar truck developed by the University of Florida was only partially successful. The dummy they were to rescue from the blazing building burned up before the team could get to it—the fire that was provided was not the type they had practiced on. Professional training, the team found, is half the battle.

Water does not smother very large fires, but serves to bring the temperature of the combustible materials below their ignition point—a move which gradually extinguishes the fire. It has been calculated that no less than a gallon of water per hundred cubic feet of space is required to accomplish this efficiently. A room a little smaller in area than two tennis courts and 10 ft. high, for example, would need a water spray of 500 gal./min. A firehose of this capacity normally takes six men to operate.

An aid in fighting large fires is the Iowa State Fire Cat, demonstrated here by one of its 12 student designers. The Fire Cat is a 500 gal./min. nozzle mounted on a vehicle with the capability of moving on terrain where ordinary road vehicles cannot travel. The vehicle is designed to pass through openings as small as six feet square and to travel down warehouse and factory hallways and aisles. The nozzle is mounted on a boom that can be lifted to a height of 10 ft. The operator can aim the nozzle in any desired direction, and the spray can be changed from solid stream to fog.

**Put the Home Fires Out**

While hundreds gathered to watch the fires on the field, the Penn State team had demonstrated its winning microfiche reader to three judges and a handful of spectators on a small Ansul equipment room.

The idea, said Jim Gourley and Jim Frazier, the project's two developers, "is to give a fire company all the information it needs to fight a fire on microfiche cards which it can bring along to the scene of a blaze." The reader, carried aboard a truck and then handheld by the firefighter coordinating the effort at a blaze, gives critical information about structures, doors, elevators, and potentially hazardous products. Firefighters have at their fingertips vital information: what chemicals or other materials might explode, what floors might cave in, the location of elevators and stairs for emergency exits—an excellent idea, relevant, cost-effective, well researched, and a real sleeper.

Winner in the "breathing apparatus, suits, and rescue" category was Georgia Tech's improved turnout coat, made of fabrics the Tech textile engineers themselves designed.

Rice University's railroad car release system won the "prevention" category. Burning railroad cars must now be manually decoupled, exposing railroad workers to serious injury. The Rice system connects with the air brakes on the train without interrupting them. Activated by a detector, the system gently brakes the train when a fire is sensed, alerting the engineer who released the burning cars by pushing a button.

Winner in the "fire fighting" category was Iowa State's Fire Cat; Washington State's hot spot detector won "detectors and sprinklers."

"It's too bad they can't all be winners," said one amazed judge.

If all this equipment, none of it extremely complicated and all of it innovative, could be developed by students working with short budgets and shorter time, why hasn't industry done it?

Charles E. Barringer, Assistant Dean of Engineering at M.I.T., believes the answer is money. "The market isn't large enough to provide an incentive. Besides, people just aren't aware of the scope of the problem."

Mr. Bland, himself a volunteer fireman for 30 years, feels the situation is due to apathy, at all levels. The budget for the New York City Fire Department is $300 million a year, Los Angeles gets $100 million, yet the U.S. House of Representatives won't even allocate $30 million to support the recommendations made by the Commission on Fire Prevention and Control. "It's not unreasonable to ask for ten per cent of the New York budget when fires cost $60 a year per capita."

# How Much Luck in the First Transfusion?

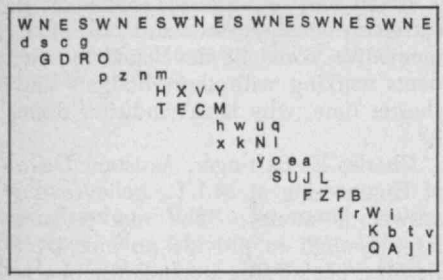
Puzzle Corner
by
Allan J. Gottlieb

I have received several letters concerning my question in the January issue about games of strategy, particularly RISK. David Rosenthal sent a partial computer analysis of RISK. In addition, I have been sent some hints on games in general which I would like to pass along. Liz and Neil Doppelt recommend BROKER and a card game called "Six-Pack Bezique" (Winston Churchill's favorite). Finally, Tom Stockfish suggests writing to Simulation Publications, Inc. (44 E. 23rd St., New York, N. Y., 10010) for a catalogue of their many strategic games.

**Problems**

**J/A 1** The following problem on the subject of "keyword bridge" is from Walter F. Penny:

A scrambled sequence of letters is formed by choosing a keyword (containing no repeated letters) and writing the remainder of the alphabet in order after it. The letters of this sequence are written as capitals on the 26 cards ♠A to ♥2. The letters of another sequence (based on a different keyword) are written as small letters on the 26 cards ♦A to ♣2. A Bridge game, contract 4♥ by S., down one, might be written as shown below.




What are the keywords?

**J/A 2** While working on an old problem, x , Neil Judell has come up with the following variant: For positive x, let $y_1 = x$, $y_2 = x^x$, and in general $y_n = x^{y_{n-1}}$. Now let $Z_n = \lim_{x \to 0} y_n$. In terms of n, what is $Z_n$?

**J/A 3** The following was submitted by Joseph Horton, who notes that the first reported blood transfusion was performed before the nature of blood typing and matching was known; therefore, it was fortunate that luck was on the patient's side. The problem: What was the probability of a successful transfusion (one in which no adverse reaction occurred among major factors)? You need to know:

| | | *Donor* | | | |
|---|---|---|---|---|---|
| | **Type** | **A** | **O** | **B** | **AB** |
| *Recipient* | **A** | ok | ok | x | x |
| | **O** | x | ok | x | x |
| | **B** | x | ok | ok | x |
| | **AB** | ok | ok | ok | ok |

| | | *Donor* | |
|---|---|---|---|
| | **rh** | **+** | **−** |
| *Recipient* | + | ok | ok |
| | − | x | ok |

The distribution of blood types in the population is approximately as follows: A—40 per cent, O—40 per cent, B—15 percent; and AB—5 percent; rh+ —85 percent and rh− —15 per cent. Types and rh's are randomly mixed—that is, 85 per cent of each type is rh+ and 15 per cent is rh−. (My wife Alice, budding immunologist, says that the above is only a rough approximation and that in reality there are many other factors besides type and rh; but for the sake of the problem, ignore her complications.)

**J/A 4** Here is a problem from John G. Connine, who describes "a lesser known game of solitaire played here in the snowbelt during long winter nights" (it is also played here in the pollution belt). A standard deck of 52 cards in shuffled and placed face down upon the table. The cards are then turned face up one at a time by flipping over the top card of the face-down stack. As this is done, the player simultaneously calls out the sequence A, 2, 3, 4, 5, 6, 7, 8, 9, 10, J, Q, K, A, 2, etc., one call being made for each card flipped over. To win the game, one must go through the deck without matching a card flipped over with the card called. Suits don't matter, so, for example, any 4-spot flipped over on the 4th, 17th, 30th, or 43rd turn results in a loss. "Since winter will surely come again," Mr. Connine would like to know what are the chances of winning the game. How about a second solution for the same game with a 48-card pinnochle deck?

**J/A 5** Frank Rubin wants you to place six points inside a unit square so that the nearest two are as far apart as possible.

**Speed Department**

**SPEED 1** The following is from Dick Boyd: Larry and Bill enjoy hot coffee with cream. What strategy should they use in adding the cream to keep the coffee hottest longest?

**SPEED 2** Mary Lindenberg asks the following real estate problem: A realtor bought a house for $16,000, sold it for $17,000, bought it back for $18,000, and resold it for $19,000. How much did the dealer make or lose?

**Solutions**

Following are solutions to problems published in the March/April issue:

**M/A 1** On a usual chessboard, define a new piece, the kknight, by letting its move be three up and two over or two up and three over (also allowing down for up, of course). Can you devise a kknight tour—that is, find a series of kknight moves such that each of the 64 squares is landed on exactly once?

This problem requires the touch of a combinatorist for its solution. Since this is one of Frank Rubin's primary interests, it is not too surprising that he did not have too much trouble: No kknight's tour is possible. Notice that at the 16 encircled cells there are exactly two moves available. Either *both* of these moves are taken in the tour, or that cell must be a terminal. Next note that the two moves at 10 and 55 both end at 29 and 36. Either the tour contains the closed circuit 10-29-55-36-10, which is impossible, or one end of the tour is a 10 or 55. The same reasoning shows that the other end of the tour must be at 15 or 50. Since both ends of the tour have now been located, all

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| (1) | (2) | 3 | 4 | 5 | 6 | (7) | (8) |
| (9) | (10) | 11 | 12 | 13 | 14 | (15) | (16) |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 |
| 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 |
| (49) | (50) | 51 | 52 | 53 | 54 | (55) | (56) |
| (57) | (58) | 59 | 60 | 61 | 62 | (63) | (64) |

of the other moves at the circled cells must now be in the tour. But these moves include a closed circuit 1-20-7-29-16-38-64-45-58-36-49-27-1. Since a tour cannot visit the same square twice, no tour is possible.

For more details the reader is urged to see an article of Dr. Rubin's to appear this fall in the *Journal of the Association for Computing Machinery*.

Also solved by R. Robinson Rowe.

**M/A 2** Find a closed form for $1^1 + 2^2 + 3^3 + \ldots + n^n$.

Judith Q. Longyear points out that no closed form is known and cites as a reference p. 471 of Vol. 53 of *American Mathematical Monthly*. In this article it is shown that (let $f(n) = 1 + 2^2 + \ldots n^n$) $n^n \left(1 + \frac{1}{4(n-1)}\right) < f(n) < n^n \left(1 + \frac{2}{e(n-1)}\right)$.

Richard T. Bumbry fiddled around with $f(n)$ mod q for various q's and has some evidence to suggest that no closed form is possible.

**M/A 3** Sometime in the morning it began to snow, and the snow continued at a constant rate all afternoon. A snowplow, which moves a constant volume of snow per unit of time, traveled twice as far between noon and 1 p.m. as it did between 1 p.m. and 2 p.m. When did it begin to snow?

This problem was somewhat more subtle than first appears. Some of the giants of puzzledom (at least of Puzzle Cornerdom) erred by assuming that there was twice as much snow on the ground at 1:30 as at 12:30. This, however, is incorrect. As the following solution (from Robert Pokoff) indicates, we must integrate the inverse proportionality:

Using C's as constants, let:
volume of snow plowed $= V = C_1 t$,
depth of snow $= h = C_2 t$,
Width of plow $= w$, and
distance plowed $= x$.
Then $dV = hwdx = C_2 t\, wdx$.
Then $dV/dt = C_2 w\, t(dx/dt)$.
But, from (1), $dV/dt = C_1$.
Therefore,
$C_2 w\, t(dx/dt) = C_1$,
$dx = C\,(dt/t)$
$x = \int (dt/t)$

If T is the interval in hours from the time the snow started until noon, and $x_1$ and $x_2$ are the distances plowed between noon and 1 p.m. and between 1 and 2 p.m., respectively, then

$$x_1 = C \int_T^{T+1} (dt/t) = C \ln [(T+1)/T]$$

$$x_2 = C \int_T^{T+2} (dt/t) = C \ln [(T+2)/(T+1)]$$

But $x_1 = 2x_2$; therefore

$$\ln[(T+1)/T] = 2\ln[(T+2)/(T+1)] = \ln[(T+2)/(T+1)]^2.$$

Therefore $(T+1)^3 = T(T+2)^2$,

$T^2 + T - 1 = 0$, and $T = 0.618$ hours before noon, or 11:22:55.

Responses were also received from R. Robinson Rowe, Avi Ornstein, John E. Prussing, Frank Rubin, Winslow H. Hartford, David Geisler, Ted Mita, Harry Zaremba, Jack Parsons, and the proposor, Doug Hoylman.

**M/A 4** This problem was revised in June, and its solution will appear with the solutions to the June problems.

**M/A 5** In each of the 16 equal squares shown place a different letter of the alphabet in such order that they will correctly spell eight *different* four-letter words, one word in each of the four horizontal rows (reading from left to right) and at the same time one word in each of the four vertical columns (reading from top to bottom), making a total of eight *different* four-letter words possible. Do not use plurals or proper nouns. All words must be defined in any one dictionary of your choice. How many words can you get?

Only George H. Lopes was able to give a complete solution. All other solutions used the same letter more than once or did not have eight words. In fact, Mr. Lopes asks for extra credit since his solution has nine words (fiat diagonally upward):

CYST
OPAH
RIMU
FLED

All of these words appear in Webster's *New International* (2nd ed.).

Other respondents were Winslow H. Hartford, Frank Rubin, and Jim Schott.

**Better Late than Never**

**PERM 1** As usual several more replies have been received. However due to the time delay between my deadline and your receiving TR, most of the "new" responses received this month contain material already published in previous issues. The one exception is the following, almost humorous, contribution from Stuart D. Casper. His up arrow is the usual teletype method of signifying exponentiation.

300 = [[√9!]/[√3!]] · 1⁷
400 = [√9!/3] · [√7 − 1]
500 = [[√9!]/[√3!]] + [√[√√7!]!] − 1
600 = [√9!] − [√7] · 1³
700 = 3!! − 17 − √9
800 = 9³ + [√7!] + 1
900 = [√√√([√√9!]!)] − (7.1 · 3!)
1000 = [√{[√√7!]!)] · (9 − 3 − 1)
2000 = [√([√√7!]!)] · (9 + 1³)
3000 = [√([√√7!]!)] · ([√√(9 − 1)!] + [√3!]
4000 = [√([√√7!]!)] · ([√√9!] − 3 − 1)
5000 = 7! − ([√[√3!!]] · (9 − 1))
6000 = [√([√√7!]!)] · [√913]
7000 = [√([√√7!]!)] · ([√3!!] + 9¹)
8000 = [√([√√7!]!)] · (([√[√3!!]]!)/√9) · 1
9000 = [√√3!!] · ([√9!] − [√7] · 1)
10000 = ([√([√ √7!]!)] · [√√√√9!]) · ([√3!!] − 1)
$10^5$ = [√([√√3!!]!)] ↑ (7 + 1 − √9)
$10^6$ = [√([√√3!!]!)] ↑ (7 − 1⁹)
$10^7$ = [√([√√3!!]!)] ↑ (7 · 1⁹)
$10^8$ = [√([√√3!!]!)] ↑ (7 + 1⁹)
$10^9$ = [√([√√3!!]!)] ↑ (9 · 1⁷)
$10^{10}$ = [√([√√3!!]!)] ↑ (9 + 1⁷)
$10^{20}$ = [√([√√3!!]!)] ↑ (19 + [√√7!])
$10^{30}$ = [√([√√3!!]!)] ↑ [√917]
$10^{40}$ = [√([√√3!!]!)] ↑ ([√√7!] · ([√√√9!] + 1))
$10^{50}$ = [√([√√3!!]!)] ↑ ([√7] · ([√√√9!] + 1))

(*Continued on p. 63*)

# Books

## Ditch-Digger and Salad Man: Down and Out in Boston?

**Blue-Collar Journal: A College President's Sabbatical**
John R. Coleman
New York: Lippincott, 1974, 252 pp., $6.95

**Reviewed by Howard W. Johnson**

When John R. Coleman left the Department of Economics at M.I.T. in 1955, there was not much doubt in the minds of his friends that he would go on to some interesting opportunities, and we all hoped that he would one day return to M.I.T. In the years that followed, he served as Chairman of the Department of Economics and Dean of Humanities and Social Sciences at what is now Carnegie-Mellon University, as a top staff man at the Ford Foundation, and finally in his present post as President of Haverford College.

Last year he returned to Cambridge and to the old neighborhood—but not to look in on his old colleagues in the Sloan Building. Instead, two doors down on Memorial Drive, he applied for a job as a dishwasher in the cafeteria at the local electronics plant. He didn't get the job and—since he had been fired the day before at Stuart's Restaurant in South Boston—the world looked bleak, as it always does for a man without a job in an unfriendly town. The next day things brightened when he caught on as a sandwich and salad man at the Union Oyster House. There he remained for a few weeks learning how to make club sandwiches and mixed salads, as he says, in a striking parallel to "the way I was introduced into the role of teacher at M.I.T. 24 years ago."

Jack Coleman was not down and out in Boston in some Orwellian replay. He was trying to understand at first hand the perspective of the blue-collar worker, seeking "to learn some lessons forgotten or never understood about the world of work." He describes his efforts to find the series of blue-collar jobs and to learn from them in this fascinating and highly readable book.

**"How Had We Grown So Far Apart?"**
Coleman's odyssey begins with a chance for some time off in the spring of 1973 from his presidential post at Haverford. The usual possibilities appear, and yet Coleman decides for reasons more complex than he can describe, that he wants some time at manual work in a different role, perhaps "to find himself again" in the standard phrase of the college sophomore. The key to his sense of search is the experience he describes in mid-book in one of the series of moving flashbacks: seeing the battle between hard-hats and anti-war student paraders in Wall Street in 1970.

"How had we grown so far apart?" he wonders. Feeling a compulsion to try to understand the views of the hard-hat in this decade, he decides to see the world from the viewpoint of a wandering hourly worker. Over a period of months he dips into that world three times—first as a ditch-digger in Atlanta, then as a sandwich-maker in Boston, and finally as a garbage man in a suburb in Washington, D.C. Each time he leaves the job after a few weeks to return to an incongruous and brief episode as Chairman of the Federal Reserve Bank of Philadelphia.

He learns a lot on the way back to Haverford. Somehow one has the feeling that he knew the substance of the experience all along: that most people are decent, but some take advantage of their fellows; that they try with difficulty to accommodate to an unfriendly world; that the work is hard, but that simple responsibilities have their rewards; that the language is crude, but only superficially so; that communication with the boss is difficult, and the relationship with the organization is remote; and that people tend to look down on garbage men.

**Mysteries Remain on the Road to Damascus**
What makes it a renewing experience for Coleman is his achievement of a personal sense of playing the role as if he were actually in it for all time. He seems to do each job with substantial satisfaction. He finds himself dependently sensitive to the pressures around him. To some, there will be a bit of artificiality in that kind of play acting. His plight is too retrievable, somehow, to be genuine. To a colleague who might wonder what was new to someone like Coleman—who has, after all, a solid reputation for being a perceptive teacher of labor and personnel relations—he would say, "You had to be there to understand."

Who can dispute him? The concrete is always more vivid than the abstract, the flesh and blood more revealing than the statistic. "Hands on" experience rightfully is getting more attention in the theory of education once again. For Dr. Coleman the "hands on" experience of a shovel, a mop, and a garbage can was highly worthwhile. He did not discover, or at least he does not report, his theory of why the manual worker should look at life the way he does or why the gap between student and hard-hat, to which he earlier refers, exists, if indeed it does.

Not all need this first-person return to the lowest-status work place to understand society, and Coleman's road to Damascus holds as many mysteries as ever. I suspect that most industrial managers could profit by a similar experience. For Dr. Coleman the trip was surely worth the effort, and his account of it is highly worth reading. I still wish he had stopped off at M.I.T. during his Boston adventure.

*Howard W. Johnson is Chairman of the Corporation of M.I.T.; he first joined the Sloan School of Management in the year President Coleman concluded his service on the faculty of M.I.T.'s Economics Department, and President Coleman was a graduate student at the University of Chicago (M.A. 1949, Ph.D. 1950) while Mr. Johnson was teaching there.*

## Security for Plutonium

**Nuclear Theft: Risks and Safeguards**
Mason Willrich and Theodore B. Taylor
Cambridge: Ballinger Publishing Co., 1974, $13.50

**Reviewed by David F. Salisbury**

Events dictate yet another close examination of the wisdom of future dependence on nuclear energy.

On one hand the world has learned that India has diverted plutonium from its commercial reactor program to construct and detonate a nuclear explosive. Canada, the country which has aided India in her efforts to develop nuclear power, has withdrawn its support and other governments have viewed with concern the "implications" of the Indian action.

Plutonium of the sort that India used for its nuclear explosive will enter the fuel cycle of commercial power reactors in the late 1970s or early 1980s if present plans proceed. It will thus be widely distributed and transported throughout the western world and in parts of Asia and South America. The authors of this volume propose that any nation, or any criminal or terrorist group with 10 to 20 pounds of plutonium, either in metallic or oxide form, could fabricate it into a crude bomb without an unreasonable amount of effort, and that the abundance of plutonium by 1980 will make this scenario at least probable by the end of this decade.

The controversy over nuclear energy has in the past centered on the safety of nuclear reactors themselves and on the problem of disposing of their highly radioactive wastes. Now a third issue has been added by Mason Willrich and Theodore B. Taylor in this study for the Ford Energy Policy Project. Drs. Willrich and Taylor document the inadequacies of the present safeguard system for plutonium and persuasively argue that nuclear theft may become the paramount danger in the near future if proper steps are not taken.

Devices can always be improvised and reactor designs improved to increase safety margins in operating power plants. New chemical processes can separate and immobilize highly radioactive wastes. But the theft of nuclear materials involves malfunctioning human beings and so will be much harder to deal with. Too little effort has been expended to date. A small but significant amount of plutonium has been separated from spent commercial reactor fuel and is now in research laboratories; more will soon be distributed in fuel for power reactors. Present safeguards are inadequate to prevent even a few armed men from stealing enough of such fissionable material to make a crude bomb. What will soon be needed, think the authors, is a federal security force devoted entirely to guarding nuclear materials, a series of elaborate detection devices in processing plants for nuclear fuel, and strict safeguarding of shipments. In the U.S. at least, this could be achieved easily enough, and for only a small percentage of the total cost associated with nuclear energy. Out-

side the United States the situation is not so promising. National sovereignty, in particular, greatly complicates the solution. For instance, India spent $216 million and five years of research in order to join the nuclear club. This was done without the knowledge of the Canadians, who have now realized that their objectives in aiding India and the Indians' reasons for accepting that aid may have been very different. Recent agreements to export nuclear power technology to Egypt and Iran have intensified concern.

"It is essential that we put our own house in order and demonstrate that we take this matter seriously," Dr. Taylor told me in an interview shortly after publication of the book. "At the same time we must push diplomatically for increased safeguards." Public discussion is essential, thinks Dr. Taylor. He hopes that once the governments of the world realize how easy it may be to make a crude bomb out of materials in their possession, they will institute the safeguards necessary to keep the risks of theft down to an "acceptable level".

But what is acceptable? "To give you a flavor of what I, personally mean," explained Dr. Taylor, "suppose the safety and waste disposal problems were solved and nuclear energy was supplying a sizeable fraction of the world's energy needs. And suppose we could keep terrorists from setting off no more than one small-scale Hiroshima every ten years. I would be hard put to say whether that was acceptable or not."

Is this a risk that we will be forced to accept? It would be truly ironic if all the money the U.S. has spent to justify development of the atomic bomb has made such a world the most probable one.

*David F. Salisbury reports on the physical sciences and technology for the* Christian Science Monitor.

# Boulding

**Continued from p. 8**

of alternative futures. A study of the evaluation or goodness function, therefore, may throw some light on what are the more probable futures. Things which are perceived as "too large" are likely to get smaller and things perceived as "too little" are likely to get bigger. If there is strong divergence of evaluations, however, decisions are likely to be frustrated. Decisions of one person will be offset by decisions of another. This perhaps explains in part what might be called the "paradox of decision"—how is it that when everybody does everything for the best that things so often go from bad to worse?

*Kenneth E. Boulding, former President of the American Economic Association, is Professor of Economics at the University of Colorado and Director of the Program on General, Social, and Economic Dynamics at the University's Institute of Behavioral Science.*

# Chase

**Continued from p. 13**

We should embrace the notion of the "negative income tax," which means family income subsidized, if necessary, to meet a decent standard of living for every American; such a plan should replace the majority of our current relief programs. Even President Nixon has advocated this priority.

We need compulsory arbitration for union contracts in all public services essential to the life of the community—fire, police, sanitation, hospitals, and the like. No more economic blackmail by strikers, any more than by Saudi Arabia. To find the able and fairminded arbitrators needed may not be too difficult after the lessons of Watergate. Ask for a list from Messrs. Cox, Richardson, and Ruckelshaus.

We should establish a high-powered Office of Technology Assessment in the federal government to examine new scientific findings and advise on how far they should go into mass production and mass use. Had such an agency existed in 1916 (the year of the Model T), the internal combustion engine might have been curbed instead of becoming, in the words of one despondent critic, "the greatest disaster to overwhelm the human race since the flood." Such an agency has already been set up in a small way in Washington. The generalist hopes for its development in a big way.

Such an agency could be of great help, too, in countering the growing—and largely ignorant—popular attack on many aspects of technology. To use the semantic approach: technology$_1$ is not technology$_2$—an oxygen tent is not an atomic missile. What kind of "technology" are we talking about? What are the referents?

Any generalist who tries to concentrate on issues can in fact think of many other necessary changes—economic, political, and military—to improve the quality of American and global life. The priorities of this particular generalist as the decade to 1984—that ominous date—begins are those listed above.

How would you amend them?

*Stuart Chase, who studied at M.I.T. with the Class of 1910 in the course in general engineering, is a prolific writer on subjects relating to economics, communication, and social affairs. Among his major books are* The Proper Study of Mankind, The Tyranny of Words, *and* The Most Probable World.

# Puzzle

**Continued from p. 61**

$10^{60} = [\sqrt{([\sqrt{\sqrt{3!!}}!)}] \uparrow ([\sqrt{7!}] - 9 - 1)$

$10^{70} = [\sqrt{([\sqrt{\sqrt{3!!}}!)}] \uparrow ([\sqrt{7!}] \cdot 1^9)$

$10^{80} = [\sqrt{([\sqrt{\sqrt{3!!}}!)}] \uparrow ([\sqrt{7!}] + 9 + 1)$

$10^{90} = [\sqrt{([\sqrt{\sqrt{3!!}}!)}] \uparrow ([\sqrt{\sqrt{\sqrt{\sqrt{[\sqrt{\sqrt{9!}}!)}}}}] \cdot ([\sqrt{7!}] + 1))$

$10^{100} = [\sqrt{([\sqrt{\sqrt{3!!}}!)}] \uparrow ([\sqrt{[\sqrt{\sqrt{7!}}]!}/(\sqrt{9} - 1))$

$10^{200} = [\sqrt{(\sqrt{[\sqrt{\sqrt{3!!}}]!)}}] \uparrow ([\sqrt{[\sqrt{\sqrt{7!}}]!}] \cdot 1^9$

$10^{300} = [\sqrt{([\sqrt{\sqrt{3!!}}]!)}] \uparrow ([\sqrt{\sqrt{\sqrt{\sqrt{[\sqrt{\sqrt{9!}}]!)}}}}] \cdot [\sqrt{([\sqrt{[\sqrt{\sqrt{[\sqrt{\sqrt{7!}}]!}}]!)}}])])$

$10^{400} = [\sqrt{([\sqrt{\sqrt{3!!}}]!)}] \uparrow ([\sqrt{[\sqrt{\sqrt{7!}}]!}] \cdot [\sqrt{9} - 1])$

$10^{500} = [\sqrt{([\sqrt{[\sqrt{([\sqrt{9}]!)}]}]!)}] \uparrow [[\sqrt{[\sqrt{\sqrt{7!}}]!}] \cdot ([\sqrt{\sqrt{\sqrt{[\sqrt{3!!}}]}}] + 1)$

$10^{600} = [\sqrt{([\sqrt{\sqrt{3!!}}]!)}] \uparrow ([\sqrt{[\sqrt{\sqrt{7!}}]!}] \cdot (\sqrt{9}) \cdot 1)$

$10^{700} = [\sqrt{([\sqrt{\sqrt{3!!}}]!)}] \uparrow ([\sqrt{7!}] \cdot (9 + 1))$

$10^{800} = [\sqrt{([\sqrt{\sqrt{3!!}}]!)}] \uparrow ([\sqrt{[\sqrt{\sqrt{7!}}]!}] \cdot [\sqrt{\sqrt{\sqrt{9!}}}] \cdot 1)$

$10^{900} = [\sqrt{([\sqrt{\sqrt{3!!}}]!)}] \uparrow ([\sqrt{\sqrt{\sqrt{\sqrt{[\sqrt{\sqrt{9!}}]!)}}}}] \uparrow [\sqrt{7} - 1])$

$10^{1000} = [\sqrt{([\sqrt{\sqrt{3!!}}]!)}] \uparrow ((9 + 1) \uparrow [\sqrt{\sqrt{[\sqrt{([\sqrt{\sqrt{7!}}]!)}]}}])$

$10^{10,000} = [\sqrt{([\sqrt{\sqrt{3!!}}]!)}] \uparrow (([\sqrt{([\sqrt{[\sqrt{\sqrt{[\sqrt{([\sqrt{\sqrt{7!}}]!)}]}}]!)}]}])] \uparrow (1 + \sqrt{9}))$

$10^{100,000} = (9 + 1) \uparrow (([\sqrt{([\sqrt{[\sqrt{([\sqrt{\sqrt{[\sqrt{([\sqrt{\sqrt{7!}}]!)}]}}]!)}]}])] \uparrow [\sqrt{\sqrt{3!!}}])$

$10^{1,000,000} = (9 + 1) \uparrow (([\sqrt{([\sqrt{[\sqrt{([\sqrt{\sqrt{[\sqrt{([\sqrt{\sqrt{7!}}]!)}]}}]!)}]}])]) \uparrow 3$

As Mr. Casper's solution makes clear, getting really large numbers using the greatest integer function is quite possible. I would really appreciate (in the mathematical sense as well) a rigorous proof of **MAY 2** which asserts as a corollary that **PERM 1** (in the loose sense) is possible for all numbers. A "constructive" proof would, of course, be preferred. I might also point out that **PERM 1** (in the strict sense—no greatest integer) is still quite a challenge. In June I published Eric Jamin's list, which has 20 gaps up to 256, and I have no answers beyond that. So how about 152, 155, etc., without greatest integer?

Responses were also received from Dr. Efrem G. Mallach, Ray Ellis, Tom Davis, Bob McConaughy, Ermanno Signorelli.

**Proposor's Solutions to Speed Problems**

**SPEED 1** Add the cream immediately in order to get the mixture temperature down to reduce the loss of heat from radiation. Radiation heat losses go as the fourth power of temperature differential. Hence the mixture will stay hotter longer if the cream is put in at once than if you wait for the coffee to cool and the cream to warm up before mixing.

**SPEED 2** Since the total expenses were $34,000 and the income was $36,000, the profit was $2,000.

*Allan J. Gottlieb studied mathematics at M.I.T. (S.B. 1967) and Brandeis (A.M. 1968, Ph.D. 1973) he is now Assistant Professor of Mathematics at York College of C.U.N.Y. Send problems, solutions, and comments to him at the Department of Mathematics, York College, 150-14 Jamaica Ave., Jamaica, N.Y. 11432.*

# An Institute Informant

**The Editors' digest of recent and current concerns at the Massachusetts Institute of Technology**

## Understanding New England Seismicity: A New Laboratory

Earthquakes in New England? Yes, "significant historic seismic activity," says M. Nafi Toksoz, Professor of Geophysics at M.I.T., but " very little careful instrumental monitoring in recent times," with the result that New England seismic activity is "an important problem . . . not studied sufficiently to be understood."

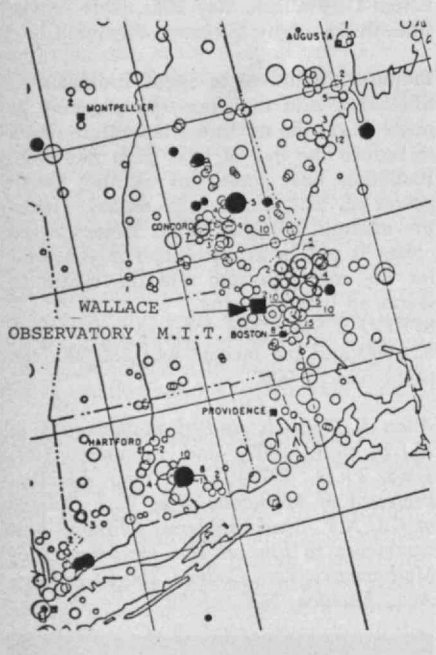
Now a geophysical observatory—a "seismic vault"—being built by M.I.T. in Westford, Mass., is designed to be the tool for correcting that shortcoming.

The observatory, in an underground room secured to bedrock, will contain sensitive instruments to record earth movements in all three dimensions, and even the small motions which result from strain accumulations. It is accurate measurements of strain accumulations, says Professor Toksoz, which promise "immense progress" in forecasting earthquake activity. Some instruments in the new laboratory will be capable of measuring movements as small as $10^{-7}$ cm., and any earthquake over 4.5 on the Richter scale anywhere in the world will be recorded. It is this ability to record "a wide spectrum of activity" which will make the M.I.T. observatory unusually valuable, says Professor Toksoz.

The 60x60-ft. observatory vault is being dug into 23 ft. of earth, and it will be covered by 15 ft. of soil. There will be a small work area at the surface and several rooms for instruments and for equipment to control temperature (variation of less than 1°F. throughout the year) and humidity.

Data from the instruments will be carried automatically to M.I.T.'s nearby Wallace Astronomical Observatory, located on the same Westford site, and to the Green Building on the campus, so that—once operating—the seisemic observatory will be entered only infrequently.

Westford data will be compared with that from M.I.T. instruments already in operation in a small observatory at Elat, Israel, and in the vault of a Harvard University observatory in Harvard, Mass., and the correlated measurements between these three sites will be of special interest, Professor Toksoz thinks.




*New England is not a region of intense seismic activity, but the circles on the map show the epicenters of earthquakes known to have occurred in the Boston area between 1534 and 1959. A new seismic observatory for M.I.T., now being built in Westford, Mass. (arrow), will substitute some information for "a lot of of conjecture about New England seismicity," thinks M. Nafi Toksoz, Professor of Geophysics.*

## Bringing Architecture Into the Present

Proposing that "architectural education is an underdeveloped area of the academic world," a consortium of eight eastern schools of architecture have successfully applied to the Andrew W. Mellon Foundation for $286,500 to conduct "an action program to improve architectural education in the U.S. to meet the needs of changing society."

The work began in June, and its headquarters have been established at M.I.T. Four studies, one on each of the four primary educational objectives, will be developed under four full-time study directors; the objectives relate architectural education to society, to the profession, to the university, and to new knowledge. The 15-month period from June, 1974, through August, 1975, will be used for these studies, and reports will follow thereafter.

The consortium institutions, in addition to M.I.T., include architecture and planning schools at Columbia, Cornell, Harvard, Howard, Pennsylvania, Princeton, and Yale. Dean William L. Porter of M.I.T. and Dean Maurice Kilbridge of Harvard are jointly coordinating the project.

## The Brain: All Else Is Trivial

Dr. Francis O. Schmitt's insistence that "to understand man we have to understand the brain" is the genesis of an immensely productive research career in molecular biology—and of a unique interdisciplinary research thrust into brain and nervous system function and behavior.

Reporting a symposium brought together by colleagues to honor Professor Schmitt (he has been a member of the faculty at M.I.T. since 1941 and an Institute Professor here since 1955), *Time* called him "The Impresario of the Brain." A more modest tribute came from Dr. Gerald M. Edelman of the Rockefeller University, one of the symposium participants; referring to the Neurosciences Research Program which Professor Schmitt founded as a kind of M.I.T.-related spin-off in 1962, Dr. Edelman said that "Dr. Schmitt has helped to bring together the most unusual combination of talented scientists in an organization that frees them of the prejudices and preconceived ideas

*"We are still in the pre-scientific stage" of understanding the brain and nervous system, says psychologist James Olds of the University of Michigan. But if—or when—we emerge from that level of primitive knowledge, some of the credit will belong to Dr. Francis O. Schmitt, Institute Professor, Emeritus, at M.I.T. who 14 years ago founded the Neurosciences Research Program, sponsored by M.I.T. and housed with the American Academy of Arts and Sciences in Brookline, Mass. This year some hundreds of his friends and colleagues honored Dr. Schmitt at a symposium and by the establishment of a Francis O. Schmitt Lectureship and Medal. The picture shows Professor Schmitt (center) with three of his guests: Dr. Julius Axelrod of the National Institutes of Health (1970 Nobel laureate in physiology or medicine), Dr. Paul A. Weiss of Rockefeller University, and (right) Dr. John C. Eccles of the State University of New York, Buffalo (1963 Nobel laureate in physiology or medicine).*

that impose themselves on any guild."

But despite N.R.P. and other brilliantly conceived research efforts, the brain and nervous system remain a complex "so vast and awe-inspiring that it makes all else simple to the point of triviality," said symposium participant Dr. Frederic G. Worden, Professor of Psychiatry at M.I.T. who serves as Executive Director of N.R.P.

Dr. A. Brodal of the University of Oslo was optimistic: "The more we know about the units of the brain, the more complete seems the pattern of their organization," he said. "We feel we are on the verge of grasping the organization principle, but we can't anticipate what it is or where it will come from," he told David F. Salisbury of the *Christian Science Monitor.*

## Reactor Modifications

For the first time since it was activated in 1958, the M.I.T. Research Reactor has been shut down for major modification—a new core design which will improve the distribution of the reactor's neutron flux.

Neutrons produced in the reactor are used in scientific research and to bombard materials to produce radioisotopes for medical therapy. At present, with the original core design, explains David D. Lanning, Professor of Nuclear Engineering who is in charge of the reactor modifications, the flux of neutrons from the fission reaction is denser at the center of the core, where radioisotopes are produced, than at the edges of the core where neutron beams are drawn off for use in scientific experiments.

The improved beam quality will be obtained by making the core more compact, increasing the neutron flux available at the beam ports three-fold. Other improvements in beam quality will be obtained by using light (ordinary) water as a coolant and moderator, and by employing heavy water as the primary neutron reflector.

The modification project involves removing the present core tank, reflector tank, primary heavy-water coolant system, and other minor systems and replacing them with new components which have been in preparation for more than a year.

Planning for the modification has been in progress for more than five years and has been the subject of a number of degree theses.

No significant changes will be made in the reactor shielding, containment building, or control instrumentation. Because the facility will continue at the same 5-mw. power level at which it has been operating since 1965, no modification of the heat exchangers, cooling towers, or other parts of the heat removal system are required. As in the past, the reactor will operate at a temperature between 100° and 130°F. and at atmospheric pressure.

A license application to upgrade the reactor was approved by the Atomic Energy Commission in April, 1973.

## Make Innovation "Go Critical"?

Where are the innovators, and what makes them succeed?

Innovation is not solely the province of the universities, nor of industry. Innovators' successes are greater in some foreign countries—notably Japan and Western Europe—than in the U.S. They can be helped—perhaps—by some government interventions; but regulation sounds the death knell of invention, and the existence of problems is no assurance of the innovation which is needed to solve them.

. . . all this from a two-day conference on "M.I.T. Research: an Industrial Resource" in Cambridge this spring.

The old cliché about university laboratories providing the fundamental science on which industry can build its innovations oversimplifies what is typically a complex—and mutually energizing—relationship. For example, said Emanuel Piore, who has just retired as Chief Scientist of I.B.M. after a distinguished career in research administration, the "computer industry was born" at Bell Telephone Laboratories, and only now are the universities "starting to catch up. We won't get a communications revolution until the universities have a real understanding of the field."

University-industry competition? Not at all. The unity of the technical community, stemming from the method and ethic which all scientists and engineers share, overrides such relatively trivial differences, he said—"a great strength to be cherished."

**Coming to Grips with Broad Issues**

Where are the innovators? What can we do to help them, and to add to their numbers? As our problems grow larger, our technology more complex, and its social implications greater, the answers to those questions are harder and harder to find. Consider, for example, energy—a widely recognized issue to which new technological inputs would be welcome indeed. The problems are so large that the new inputs we need will almost surely be the result of teamwork, not of the devotion of a single innovative individual. To form and maintain teams requires major financial support, and to bring their results into a system as big as our energy industry will require large amounts of capital. Two reasons why it's not happening:

—Most of the U.S. energy industry is subject to intensive government regulation, and " 'large pay-off' are threatening words to a regulatory body," says Robert A. Charpie, President of Cabot Corp. Under these conditions, it's hard for industry to justify large-scale investment in risky research and development.

—Energy is omnipresent—a problem throughout society, an issue involving both technology and policy, and a concern of scores of government agencies. It was relatively easy to mount major university research and development efforts for a single government "client" —N.A.S.A., for example—to work for a single goal—spacecraft guidance and control systems, in the example. Energy is different. There are "no single assured sponsor, no single technology, no single point of view," said President Jerome B. Wiesner. That's why Albert G. Hill, M.I.T. Vice President for Research, finds that, though "financing single energy projects is no problem," there are real difficulties in organizing studies "that reflect on the country's energy system as a whole."

Energy is but one example of such technology-policy areas for which support is elusive: transportation and health care delivery are two more. We simply have no way to come to grips with the broader issues, said Professor Hill; the problem is "how to make the work go critical," how to gain the longer reach.

**Can the Government Help?**

There is ample precedent overseas, said J. Herbert Hollomon, Director of the M.I.T. Center for Policy Alternatives. Most European countries, for example, understand that the creation of a new technical concept is but the first step of innovation. There remain the processes of marketing—"the entrepreneurial act of introducing the concept so that it can replace a previous method"—and promotion. We in the U.S., says Dr. Hollomon, "become mesmerized by research and development" and so have failed to foster the other two stages in the process of innovation.

Responding to a Presidential directive of 1973, the National Science Foundation now has a list of 200 possible federal actions which could help stimulate innovation and a set of four conditions under which various of these might be used, said C. Branson Smith, Director of N.S.F.'s Office of Experimental R & D Incentives. The conditions revolve around how profitable the research and development result is likely to be to a single investor, and how expensive. The government's options range from "hands off" to risk-sharing (in the form of low-interest loans), and there are also some alternatives to extend patent and anti-trust protection to innovators.

But a policy problem here, thinks Dr. Smith: "Can the federal government offer different incentives to different entrepreneurs and innovators?"

# Vannevar Bush, 1890-1974: Innovator of Engineering, Architect of Its Role

Vannevar Bush (M.I.T. Eng.D.'16), an innovative engineer and persuasive statesman of U.S. science whose sharp Yankee tongue, gritty voice, and brusque manner belied his humanity and great personal warmth, died at his home in Belmont, Mass., on June 28. He was 84.

Since 1919 Dr. Bush had served M.I.T. as a member of the faculty in the Department of Electrical Engineering, Vice President and Dean of Engineering (1932 to 1939), Chairman of the Corporation (1957 to 1959), and Honorary Chairman of the Corporation (1959 to 1971). But his service to the nation and to the Institute far outstripped any that could be implied by a list of titles, however prestigious. Perhaps as well as any other of many eulogists, Robert Reinhold paid tribute to Dr. Bush in the *New York Times* on June 30:

"A master craftsman at steering around stubborn obstacles, whether they were technical or political or bullheaded generals and admirals, Vannevar Bush was the paradigm of the engineer—a man who got things done.

"It was this skill, along with a hard-boiled Yankee shrewdness and driving energy, that he brought to the task of mobilizing American scientists and engineers for World War II. He directed the work of 30,000 men throughout the country and had over-all responsibility for developing such sophisticated new weapons as radar, the proximity fuze, fire control mechanisms, amphibious vehicles and ultimately the atomic bomb—devices that overnight revolutionized the concept of war.

"In this, he was widely credited not only with having made a decisive contribution to the Allied victory, but also with establishing a system of national support for basic scientific research that has since made American science the most vigorous and productive in the world."

"More than any other person in this country, he made the public realize the contributions of science and technology to the modern world. . . . a man of great compassion and enormous humanity."—Dixie Lee Ray, Chairman of the U.S. Atomic Energy Commission.

**An Incurable Inventor of Gadgets"**

Born in Everett, Mass., and raised in Chelsea where his father was a Universalist clergyman, it was natural for Vannevar Bush to attend Tufts College, where he received B.S. and M.S. degrees in 1913. He worked briefly in industry and at Tufts, then enrolled for his doctorate in a program operated jointly by M.I.T. and Harvard. He worked on antisubmarine research during World War I at New London, Conn. and finally found his place as Associate Professor of Electrical Power Transmission at the Institute in 1919.

Soon thereafter came Dr. Bush's de-

*Three pictures record three facets of the remarkable career of Vannevar Bush as engineering innovator, academic leader, and scientific statesman:*
*—In his early work at M.I.T. Dr. Bush felt acutely the need for a machine to help analyze electric power systems which were rapidly becoming too formidable for conventional calculators; hence his differential analyzer (top), which—in 1931—was a pioneering precursor of modern analog computers.*
*—In 1932, two years after Karl T. Compton became President of the Institute, Dr. Bush become his principal colleague as Vice President and Dean of Engineering; while Dr. Compton worked to develop the institute's strength in science, Dr. Bush led equally important efforts in engineering teaching and research. The picture at the left shows the two in Dr. Compton's office as Dr. Bush's appointment to the new post was announced; the portrait is of George Eastman, who gave funds for M.I.T.'s new campus in 1916.*
*—As World War II approached, Dr. Bush was among the most farseeing and articulate advocates of the role of science and technology in military success, and for six years beginning in 1941 he mobilized and directed the immensely significant wartime work of thousands of American scientists. So it was in 1947 that he and nine colleagues were invited by President Harry S. Truman to receive the nation's thanks at the White House. In the picture above are (seated) James B. Conant, President of Harvard; President Truman; and Alfred N. Richards, Vice President of the University of Pennsylvania; and (standing) President Compton; Lewis H. Weed, Director of the Johns Hopkins Medical School; Dr. Bush; Frank B. Jewett (M.I.T. '09), President of the National Academy of Sciences; Jerome C. Hunsaker (M.I.T. '12), Chairman of the National Advisory Committee for Aeronautics; Professor Roger Adams of the University of Illinois; Professor A. Baird Hastings of Harvard; and Professor Alphonse R. Dochez of Columbia University.*

"He was one of the great figures in the history of M.I.T. and the nation."—James R. Killian, Jr., Honorary Chairman of the M.I.T. Corporation.

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velopment of an analog machine called the product integraph for solving complex electrical network systems; it was the first in a series of machines which were precursors to modern computors. These included a differential analyzer in 1931 and, by 1942, a very large analog computer known as the Rockefeller Differential Analyzer which became a vital tool for radar and fire control technology during World War II.

Meanwhile, Dr. Bush was collaborating on private inventions and entrepreneurship as well. He was "an incurable inventor of gadgets," wrote Mr. Reinhold. A gaseous rectifier to supply electricity to radios became the principal product of the American Appliance Co., now the Raytheon Manufacturing Co., and the Spencer Thermostat Co., set up to market a new metal heat control unit, became the Metals and Controls Corp.

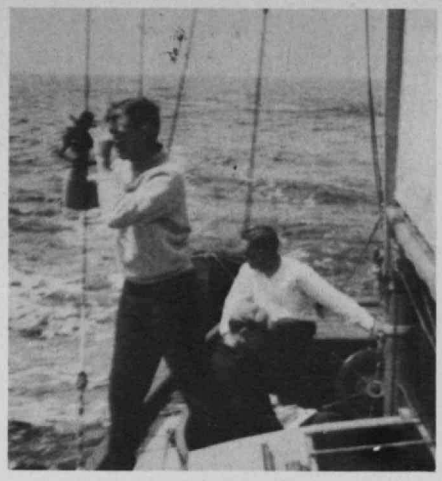
Other inventions were more for fun than profit: a machine mounted on bicycle wheels to survey land, a bird feeder to discriminate against bluejays and pigeons, a hydrofoil boat, and a number of sophisticated medical devices.

**"Science, The Endless Frontier"**

In 1939, after seven years as Dean of Engineering and Vice President of M.I.T., Dr. Bush was named President of the Carnegie Institution in Washington, and it was from that post that he was called for his distinguished service as Director of the Office of Scientific Research and Development between 1941 and 1946. In a nutshell, Dr. Bush first set out to convince President Franklin D. Roosevelt of the potential of science and engineering to contribute to the military effort of World War II and then was given the task of organizing that immense contribution.

At the end of the war, before returning to the Carnegie Institution, Dr. Bush prepared at President Harry S. Truman's request an analysis of how the scientific progress achieved during World War II could be continued and molded to peaceful purposes. This was *Science, the Endless Frontier,* the manifesto for post-war science that resulted in continuing federal support of basic research and creation of the National Science Foundation.

Other books included *Modern Arms and Free Men,* the story of the World War II achievements, and *Pieces of the Action,* a series of autobiographical essays. Honors, awards, and honorary degrees came to Dr. Bush from governments, professional societies, and major universities in numbers so great that they cannot be listed here.



*A photographic reminiscence of Vannevar Bush, D.Eng.'16, whom President Jerome B. Wiesner calls one of "the greatest scientists of our era" (clockwise from the photo above):*

*—Two of Dr. Bush's colleagues who contributed to the series of analog computers which began with the primitive Product Integraph in 1925 are shown with him (center): the late Henry B. Phillips (left); Head of the Mathematics Department, and Harold L. Hazen, '24, of the Department of Electrical Engineering (later Dean of the Graduate School).*

*—Pictures of Vannevar Bush afloat are rare, though sailing was a favorite hobby; the one at the top shows him with Professor Arthur C. Hardy, '18, of the Department of Physics somewhere off the coast of Maine in the 1930s.*

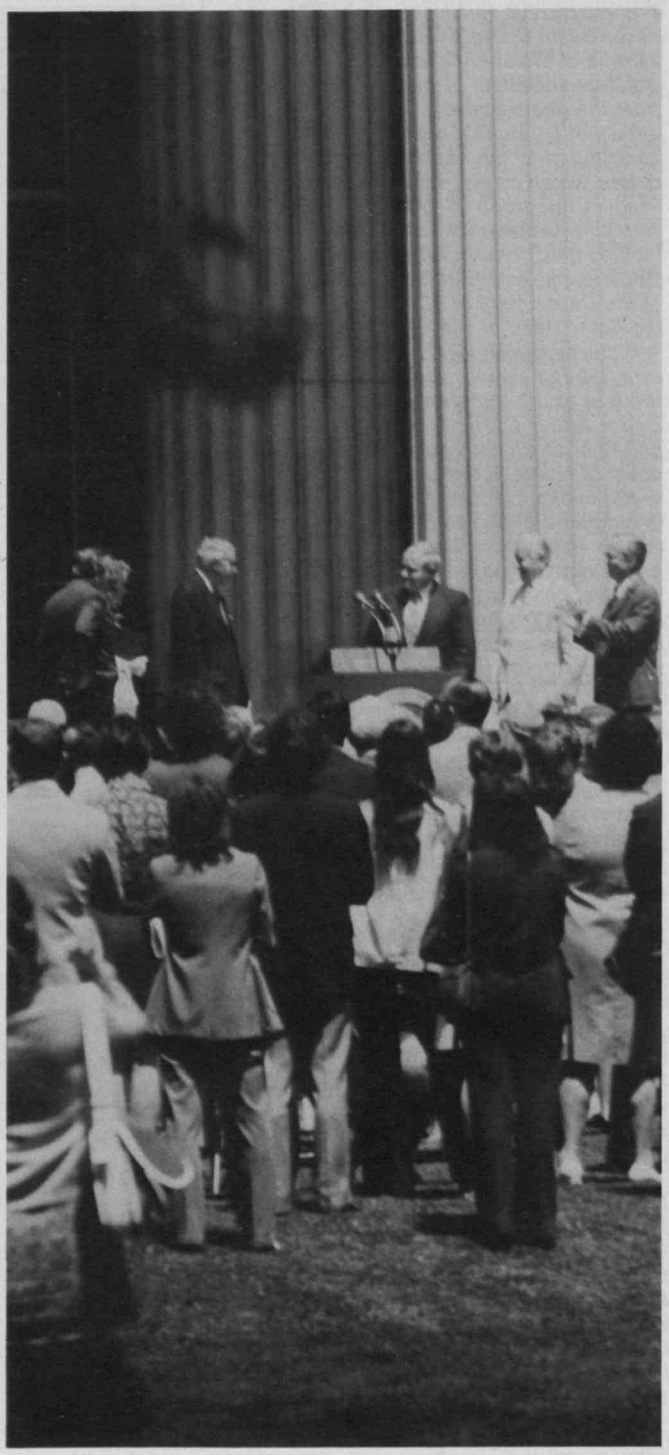
*—As knickers and vests have given way to simpler clothes, so Freshman Camp (where this picture was made in 1932) has given way to on-campus orientation. With Dr. Bush (right) greeting the new class just after he was named Dean of Engineering were the late President Karl T. Compton (left) and the late Samuel C. Prescott, '94, who in 1932 had just been named Dean of the School of Science.*

*—In 1957 Dr. Bush joined hundreds of American business leaders at the fifth anniversary of the Sloan School of Management. Among guests at the head table were Cleo F. Craig, Chairman of A.T.&T., Julius A. Stratton, '23, then Chancellor of the Institute; Andrew T. Kearney of the firm which bears his name; Dr. Bush, and Frederick R. Kappel, President of A.T.&T.*

*—Always loyal to M.I.T. alumni—and a great favorite among them—Dr. Bush never missed an Alumni Day if he could help it. The picture shows him (center) with the late Edwin S. Webster, '88 (left), and the late Horace S. Ford, Treasurer of the Institute, in 1936.*

*—At the White House in January, 1964, Dr. Bush received the 1963 National Medal of Science from President Lyndon B. Johnson; between them is Dr. Cornelius B. van Niel of the Hopkins Marine Station of Stanford University, another medalist. (Photos: M.I.T. Historical Collections)*

# Institute Review



*Just as the Great Court has been the visual symbol of M.I.T. for nearly six decades, so has James R. Killian, Jr., '26, been a personification of the Institute's leadership in education and technology for a quarter of a century. Thinking thus, members of the M.I.T. Corporation on Commencement Day approved by acclamation a proposal to name the Court in Dr. Killian's honor, and the Corporation's resolution was communicated to 1,000 members of the greater M.I.T. community on June 2 in the Killian Court. Participants in the simple but moving ceremonies included (left to right in the picture at the right) President Jerome B. Wiesner, Dr. and Mrs. Killian, Chancellor Paul E. Gray, '54, President Emeritus Julius A. Stratton, '23, and Chairman Howard W. Johnson. Mrs. Killian, about to speak in the photo above, recalled some of her own poignant moments in the Court and proposed that its greensward "be a lilting legacy to all!"*

# The Great Court Is Named for M.I.T.'s Tenth President; an "Extravagant" but "Exquisitely Appealing" Honor, he Says

M.I.T.'s Great Court, thinks James R. Killian, Jr., '26, is "an oasis of beauty and serenity," and from it he and Mrs. Killian—like many other members of the Institute community—have over the years taken great "refreshment of spirit." It is a lawn "no less movingly beautiful," he says, than that designed by Thomas Jefferson for the University of Virginia, from which M.I.T.'s architect Welles Bosworth ('89) drew his inspiration.

Now—by unanimous acclaim of the M.I.T. Corporation meeting on May 31—it is the Killian Court.

The Corporation had sought for some years for a memorial appropriate to Dr. Killian's contributions to M.I.T. and to the nation, says President Jerome B. Wiesner. When finally told of the decision, Dr. Killian said, he found it "extravagant. . . I had never imagined that this lovely central quadrangle of the Institute might ever bear anyone's name and certainly not that of Killian."

But the Corporation insisted; its action was taken "with deepest gratitude and emotion" to recognize Dr. Killian's "superb leadership . . . through 50 years of total dedication to this institution."

". . . He has cultivated and helped to fulfill M.I.T.'s highest aspirations," said the Corporation's resolution. "No single individual has done more to advance M.I.T.'s purpose and plan. . . . By his gift of lucid exposition he has made clear the complex problems and policies and conveyed the objects, aims, and spirit of M.I.T. to a wider audience. His catholicity of mind and his enjoyment of beauty have given him the qualities of scientist and engineer as well as those of humanist, scholar, and artist. His belief in the fundamental importance of the individual has been communicated to generations of students and teachers in his own pride of workmanship and by his own monumental example of personal achievement. His perception into individual needs and concerns has shaped the lives of countless members of the M.I.T. family over the years, and endeared him to them, and them to him."

The tribute to Dr. Killian came at what President Wiesner called "a national assembly of the M.I.T. family" on Alumni Day, June 3; perhaps 1,000 people—alumni and their families and members of the faculty and staff—were gathered in the Great Court. It was a "Great Court" spring day—bright and brisk. Dr. and Mrs. Killian; President Wiesner; Howard W. Johnson, Chairman of the Corporation; Julius A. Stratton, '23, President Emeritus; and Paul E. Gray, '54, Chancellor, had places on a platform surrounded by white azaleas and junipers looking out at the green sweep of the Court. Gold-yellow banners between the columns of the Maclaurin Building moved in the breeze, and a brass choir assured the importance of the occasion. It was, said Dr. Wiesner, "a memorable moment in the history of the Institute."

President Wiesner spoke of Dr. Killian's "singular contributions to M.I.T. and all of humanity. . . . It is safe to say," he said, "that no one has served M.I.T. more devotedly or with greater effectiveness than the man we honor today."

Dr. and Mrs. Killian were deeply moved. Dr. Killian's statement, using language at once formal yet very human in the style which everyone at M.I.T. associates with the Institute's tenth President, said he simply did not know how to respond to "a resolution so magnanimous, so felicitously phrased, and so heartwarming in spirit." The occasion, he said, gave him and Mrs. Killian "the happy opportunity to express . . . the ever-deeper tenderness that we feel for these colleagues whom we have loved and admired and depended upon.

"May this court always serve to say these things for the Killians."

Mrs. Killian, speaking extemporaneously, expressed her own "heartfelt thanks. . . . Always may Killian Court be a lilting legacy to all!" she said.

Dr. Killian, the first alumnus to serve as President of the Institute, received his S.B. degree in business and engineering administration—a course now incorporated into the Sloan School of Management—and he has been a member of the Institute staff ever since. His first assignment was with *Technology Review*, of which he was Editor from 1930 to 1939. Dr. Killian then joined the President's Office as Executive Assistant to Karl T. Compton, later—as Dr. Compton's governmental duties as science adviser during World War II increased in intensity—becoming Executive Vice President (1943-45) and Vice President (1945-49). Upon completing ten years as President of the Institute, Dr. Killian was named Chairman of the Corporation in 1959, and since 1971 he has been Honorary Chairman.

Meanwhile, he had been in 1957 to 1959 the first White House science adviser as Special Assistant to President Dwight D. Eisenhower, and he has before and since then fulfilled with distinction a wide variety of public and private assignments in activities relating science and engineering to human affairs.

**"...to designate this central place, which is the signature of the Institute,... to perpetuate our homage to his great service..."**

*Following is the text of the resolutions of the M.I.T. Corporation adopted on May 31 naming the Great Court in honor of James R. Killian, Jr., '26, tenth President of the Institute.*

*Resolved:* That the Corporation and the President of the Massachusetts Institute of Technology unanimously and joyfully acclaim the superb leadership of James Rhyne Killian, Jr., through 50 years of total dedication to this institution.

We speak for the entire M.I.T. community of students, faculty, staff, employees, alumni, and friends everywhere. We speak with deepest gratitude and emotion in expressing M.I.T.'s lasting debt to Dr. Killian for his extraordinary service as tenth President of the Institute, fourth Chairman of the Corporation and principal architect of M.I.T.'s development for more than 25 years. We take pride and unbounded joy on this occasion in naming the Great Court of M.I.T. in his permanent honor, hereafter to be known as Killian Court.

Dr. Killian's association with M.I.T. began over 50 years ago, when he entered as an undergraduate from Trinity College in North Carolina. Twenty-five years later he became the first alumnus to serve as President of the Institute. From the

beginning, he brought rare qualities of mind and spirit which have left a unique mark on the Institute. No single individual has done more to advance M.I.T.'s purpose and plan, as he has done, working in tandem with Dr. Compton and later with Presidents Stratton, Johnson, and Wiesner.

As alumnus of the Alfred P. Sloan School of Management, as administrator of his alma mater, as Science Advisor to four U.S. Presidents, as academician and spokesman for the nation's scientific community, as the father of Public Television, and as trustee of numerous public service institutions, he has cultivated and helped to fulfill M.I.T.'s highest aspirations. By his gift of lucid exposition he has made clear the complex problems and policies and conveyed the objects, aims and spirit of M.I.T. to a wider audience. His catholicity of mind and his enjoyment of beauty have given him the qualities of scientist and engineer as well as those of humanist, scholar and artist. His belief in the fundamental importance of the individual has been communicated to generations of students and teachers in his own pride of workmanship and by his own monumental example of personal achievement. His perception into individual needs and concerns has shaped the lives of countless members of the M.I.T. family over the years and endeared him to them and them to him.

His career in the Alumni Association was marked by innovation in alumni organization, communication, and financial support. He laid the groundwork for the establishment of the Alumni Fund. His administrative career at the Institute was marked by innovation in teaching and undergraduate studies, with more choices open to students and a more flexible and less vocational curriculum, deepened by science and broadened by augmented resources in the humanities and the arts. The establishment of two of the current five schools and the rise of graduate education and research and new advanced degree programs have been part of a panoply of progress under his leadership, which has brought M.I.T. international renown as one of the top five educational institutions in the world.

His vision of a grand and enduring design for M.I.T.'s future led to new organizational concepts and new means of linking the parts of the Institute together and the whole with the broader public it serves. His ability to translate concepts into action followed naturally. A "university polarized around science," as he first stated it, could only demand first-rate performance of itself and all of its members. "Funding M.I.T.'s independence," as he further saw it, meant constant awareness of the Institute's private character and determined vigilance in securing the needed resources to do the job. In the process, three-fourths of the Institute's invested funds were accumulated since his election as President in 1948.

As the Institute doubled in physical size under his watchful care, it grew qualitatively and intellectually. It was bigger but, more importantly, it was better. Throughout it all he has worked tirelessly and self-effacingly to strengthen the bonds of our corporate fellowship and to enhance our shared sense of purpose.

In these changes, Dr. Killian has played a gallant and central role. So, too, has Elizabeth Killian, and we honor them both as they have showered this institution with grace beyond recall. They have shared the mountain climbing together, and their sharing is a living legacy to M.I.T.

In recording these achievements, we note that Dr. Killian's disciplined energy, his wise judgment, his sensitive, warmly understanding relations with his colleagues, and his humility are inborn traits, in whose good furtune we have all shared. We also know that he has drawn great strength from the benign environment in which he has worked for M.I.T.'s advancement over the years.

Over 30 of these years have been spent in quarters looking out upon the Great Court of M.I.T. There the elegant beauty and quality of Bosworth's design have brought inspiration and comfort to M.I.T. presidents since President Maclaurin's time.

We know that the Court has been close to Dr. Killian and that it has symbolized for him the unchanging values which underlie M.I.T.—though its mantle and foliage change with seasonal variation. We know that it is a place of beauty and rest and dignity that has been close to him as he has watched the changing seasons and that his greatest satisfactions have come when gathering there to meet with the M.I.T. family, as he has so often done at Commencement and Alumni Day and in high ceremonies through the years. Therefore, it is our wish to designate this central place, which is the signature of the Institute, as a permanent tribute to him and to perpetuate our homage to his great service by calling it Killian Court.

*Be It Further Resolved:* That the Corporation and the President express their great satisfaction that James Rhyne Killian, Jr., will continue his vital and active association with the Corporation as a Life Member and as its Honorary Chairman. We will continue to look to him for the exceptional poise, unity, and sense of direction which have enabled M.I.T. to move forward with giant strides and high confidence, now and in the future.

**"...no one has served M.I.T. more devotedly or with greater effectiveness or for longer than the man we honor today..."**

*Following are the remarks of Jerome B. Wiesner, President of M.I.T., at a ceremony on June 3 naming the Institute's Great Court in honor of James R. Killian, Jr., '26, Honorary Chairman of the M.I.T. Corporation.*

The M.I.T. Corporation at its meeting on Friday voted to name this Great Court "Killian Court" in recognition of Dr. Killian's singular contributions to M.I.T. and all of humanity.

Throughout its history, M.I.T.'s sons and daughters have made unique contributions to the development and welfare of our beloved country, and inspired alumni have contributed to the greatness of M.I.T. through their teaching, their leadership, and their financial support and through the inspirational examples of productive, creative, happy lives. The parade of M.I.T. alumni stretches forward in time from the Civil War across two centuries and spans more than 100 nations; it numbers more than 80,000 persons. Its members have had a mighty role in the building of America—its industries, its educational institutions, and its government.

In this parade a few stand tall, visible to all—respected for their outstanding accomplishments and revered for their human qualities. Such a man lives among us—he has for half a century—and his contributions to the greatness of M.I.T. and the nation are indeed awe-inspiring.

It is safe to say that no one has served M.I.T. more devotedly or with greater effectiveness or for longer than the man we honor today. He guided the Institute through the dislocations of World War II, helped steer the wartime Radiation Laboratory, provided the inspiration and leadership for the post-war development of M.I.T.—revitalizing and strengthening traditional disciplines and extending the reach of academic programs in the social sciences, humanities, and management. He played a major part in the development of M.I.T.'s world-renowned faculty and in the building of its superb physical plant and the endowment that support both. Across the length and breadth of this land there are many who speak affectionately of Jim Killian as their most expensive friend. His enthusiasm for M.I.T. is highly infectious.

Dr. Killian's public structures match his local monuments. The Public Broadcasting System, now grown to maturity, was fathered by Jim Killian and only recently was given a much needed parental assist by him.

Dr. Killian's many accomplishments as President Eisenhower's Special Assistant for Science and Technology would require a symposium to do them justice, but a few stand out in my memory—the successful reorganization of the space program, enhanced basic research and higher education programs for the United States, the rationalization of the Defense Department research and development effort, and effective technical support for the President's efforts to halt the arms race and stop nuclear testing. Dozens of other public service accomplishments are equally part of Jim's stamp on America.

Dr. Killian has served with wisdom as a director of several great corporations and foundations where his unique mixture of courage, readiness to learn, wisdom, and humility have made him an exceptional contributor.

I have had the rare good fortune to be associated with Dr. Killian most of my professional life here at M.I.T. and in

governmental activities, and I must confess that my admiration and affection for Jim, and awe of him, still continue to mount. He approaches each day and each problem that he confronts with enthusiasm, care, grace, and total commitment. He enriches his life and ours with involvements in art and literature and through his own artful prose.

In reflecting on Jim's powers, wonderful human qualities, and magnificent accomplishments, one's thoughts inevitably turn with affection and admiration to the person who shared it all with Jim—a great woman—Elizabeth Killian, our beloved Liz. In thinking ahead to this occasion Liz remembered an earlier day here about which she sent me a note:

"In the balmy Spring of 1956, three people took a walk from the M.I.T. President's House to the Great Court—grandfather, grandmother, and grandson. They wanted to partake of the regreenery of the world. Grandfather was the sturdiest of the walkers and was very protective. Grandson had the excessive energy and uncontrolability of an 18-monther, and grandmother lacked balance after two paralytic strokes. (A footnotish aside, grandson is now in college and grandmother is much stronger.)

"Upon reaching the Great Court grandmother very readily sat down on one of the benches there and let grandfather watch over grandson's response to the extensive space. In looking at grandfather against the M.I.T. dome, grandmother remembered his reference to the dome in his inaugural address as M.I.T.'s 'marble index'—like Wordsworth referring to the statute of Newton in his college days in Cambridge as the—

'Marble index of a mind for ever Voyaging through strange seas of Thought.'

Grandfather's great loves were well represented then and there, grandmother thought—his family, nature and M.I.T. The picture in the mind is one grandmother will never forget.

"Signed, Grandmother Killian"

This Great Court has existed for slightly more than the 50 years of Jim Killian's association with M.I.T., waiting, it seems to me, for a felicitous name. Jim Killian and the Great Court appropriately honor each the other. This is a memorable moment in the history of the Institute.

**"...an oasis of... beauty and serenity, one of the loveliest on any American campus..."**

*Following are the remarks of James R. Killian, Jr., '26, responding on June 3 to the resolution of the M.I.T. Corporation naming the Great Court in his honor the Killian Court.*

No accolade which has come to me in my lifetime has moved me so deeply as this action of the M.I.T. Corporation. I simply do not know how to respond adequately to a resolution so magnanimous, so felicitously phrased, and so heartwarming in spirit. When I was first told that the Corporation might do something as extravagant as this, I was both startled and skeptical; in fact, I had never imagined that this lovely central quadrangle of the Institute might ever bear anyone's name and certainly not that of Killian. And yet when it happened, it would have been ungrateful of me not to accept, so novel and exquisitely appealing, so marked by benevolence and good will, was the proposal.

I had come to love the Great Court and to be proud that the Institute had an oasis of such beauty and serenity, of such "firmness, commodity, and delight"—one of the loveliest on any American campus. Francis Bacon, whose name is incised on one of the pylons in the Great Court, along with the historic names of many famous creative figures of the world, said in one of his Essays:

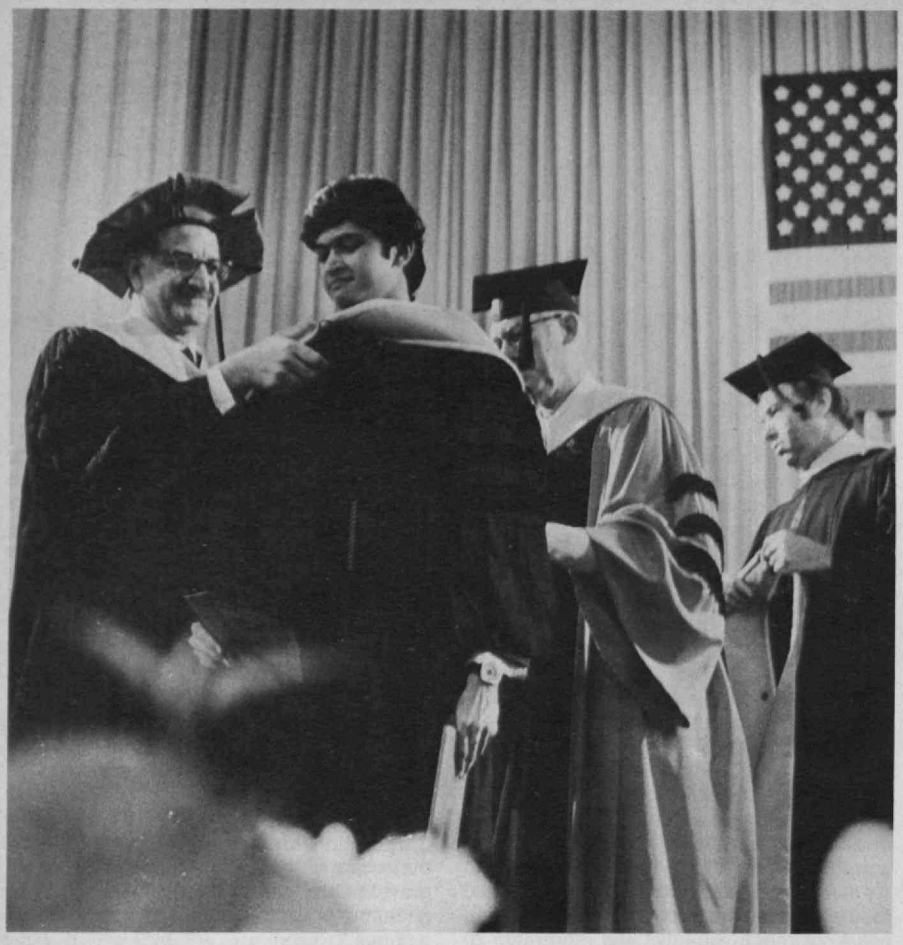
"God Almighty first planted a garden. And indeed it is the purest of human pleasures. It is the greatest refreshment to the spirits of man; without which buildings and palaces are but gross handiworks; and a man shall ever see that when ages grow to civility and elegancy, men come to build stately sooner than to garden finely; as if gardening were the greater perfection."

And this is the way it has happened at M.I.T. Certainly over the years I have found in the Great Court the refreshment of spirit of which Bacon spoke, and the quadrangle has come to symbolize for me those qualities of humanity which I had always found among the M.I.T. community. I have also come to know something of the history of the Great Court, and this made the Corporation action still more meaningful to me.

When plans were being drawn for the new Institute in Cambridge, President Maclaurin and architect Bosworth went to the University of Virginia and found inspiration in Jefferson's design; and Maclaurin surely must have recalled Cambridge University, his alma mater, where the largest of the college courts was that of Trinity College and is known as the Great Court. William Barton Rogers, our founder, who came to Boston from the University of Virginia, would certainly have been delighted that M.I.T., too, was to have a "lawn," as they call it at Virginia, in its own way no less movingly beautiful than Jefferson's.

And I know something of the record of all the memorable events that have happened in the Great Court over the years. There is an old proverb that says that gratitude is the heart's memory; and my heart, filled as it is with gratitude, is crowded with stories I have heard of occasions great and small that took place here, including the memorable pageant which marked the dedication of the new Institute in 1916. I was here in 1928, when Horace Ford, then Bursar, and Everett Morss, '85, then Treasurer and Corporation member, hoarded the funds that were used to transform a Sahara of gravel in the court into what *The Tech*, in a burst of enthusiasm, called a "real campus."

One of the happiest and truest statements in the Corporation resolution is the sentence which says of me that I have "drawn great strength from the benign environment in which he has worked . . ." Indeed I have. In the deeply felt benediction that I would leave with you, is this fact: how much Liz and I owe to our colleagues—personnel, students, staff, faculty, Corporation, alumni—with whom we have had the privilege of working these many years and whose devotion to M.I.T. has made our modest contribution possible. I speak with special admiration and indebtedness for the superb leadership of the three gifted men here on the platform who have served as President of the Institute. M.I.T. has grown in strength and power of service because there was faith and because men and women of all stations cared for it and were willing to struggle to insure that the institution fulfilled its potential. I cannot tell you how deeply I feel the privilege of having stood upon the shoulders of these men and women. To each of you who have provided help, good will, and friendship, Mrs. Killian and I speak with appreciation, devotion, and affection. And this occasion today gives us this happy opportunity to express, as we fade away year by year, the ever-deeper tenderness that we feel for these colleagues whom we have loved and admired and depended upon. May this court always serve to say these things for the Killians.



*The ceremony may have been traditional, but for its principal participants everything was new. As President of the Alumni Association, William S. Edgerly, '49, had his turn to be Chief Marshal (above); and outstanding among more than 1,300 graduates were (right) Charles A. Cofield, '73, whose Master's thesis on "The Disabled Pedestrian: Human Factors" was based on personal experience, and Kevin W. K. Tong, who received five (count them!) M.I.T. degrees during the Graduation Exercises.*

## Commencement: 1,475 Degrees, Five Married Couples, 125 Women, and More Innovations to Come

As the years march by, each Commencement seems at once unique—and yet the same as all its predecessors . . .

. . . unique for each of the thousand-and-more graduates and their parents, for the 50-year class back to relive their own last day as M.I.T. undergraduates, for the President of the Alumni Association whose leadership of the academic procession is the climax of a one-year term of office.

. . . the same for those of the Registrar's Office and Committee on Commencement whose task is to assemble in du Pont Gymnasium a procession of students in precisely the same order as the diplomas on the podium in Rockwell Cage (it is a vigorously protected M.I.T. tradition that each graduate receive his own diploma from the hand of the President in the Graduation Exercises), for the physical plant staff who annually convert an athletic hall into a ceremonial auditorium, for those who, like an editor, see events repeated and schedules precisely fulfilled.

But the similarity can only be shallow, for each Commencement is as different as the students it honors and the times which it serves.

### "Some of Each of Us"

There were 1,300 graduates, receiving 1,475 degrees, in the Rockwell Cage on Friday, May 31. Among them were 125 women, the largest number of co-eds by far in any M.I.T. Graduation Exercises (the previous record was 99 in 1973), and five married couples:

—Suzann Thomas and Leonard G. Buckle ('64), both of whom received Ph.D. degrees in urban studies and planning; they were co-authors of a single thesis ("Bargaining for Justice: Plea Bargaining as Reform in the Criminal Courts"—they insisted that "each sentence has some of each of us in it"), both were Instructors in the Department of Urban Studies and Planning in 1973-74, and both will join the faculty as Assistant Professors in the Department next fall.

—William L. ('67) and Elizabeth A. N. Hsu ('74); Dr. Hsu received the Sc.D. in mechanical engineering, Mrs. Hsu the S. B. in biology.

—Bruce D. ('74) and Anne B. Schobel ('74), both of whom received S.B. degrees in mathematics.

—Sze-Hoi and Bik-Kwoon Tye, both of Hong Kong, who received Ph.D. degrees in physics and biology, respectively.

—George E. and Patricia K. White, both of whom received Ph.D. degrees in nutrition and food science with theses in the field of nutritional biochemistry and metabolism.

But the audience's strongest accolade was reserved for Charles A. Cofield, '73, as he received his third M.I.T. degree—the Master in City Planning. Paralyzed in an accident during undergraduate days at Howard University, Mr. Cofield received his degree in a wheel chair on the floor of Rockwell Cage; President Jerome B. Wiesner descended from the

platform to present it to him. Mr. Cofield's thesis was "The Disabled Pedestrian: Human Factors;" he has been Chairman of an Inter-Campus Committee for Handicapped Students, and he has been instrumental in bringing to M.I.T.'s attention the need for special facilities—ramps, maps, and dormitory equipment—for handicapped students.

More applause came for Kevin W. K. Tong of Hong Kong; he received five degrees during the Graduation Exercises—the first M.I.T. graduate, at least in recent years, to earn so many at once. As a result of what he describes his "very wide" interests, Mr. Tong received Mech.E., S.M., and S.B. degrees in mechanical engineering and S.B. degrees in electrical engineering and management.

**Partnership and Fellowship**

President Jerome B. Wiesner opened his address to the new graduates with a word to their parents: "I congratulate all of you," he said. "There is no adequate way to recognize what you have done to help make this day possible."

Dr. Wiesner had special praise for the class, as well. In 1970, when its members entered as freshmen, Dr. Wiesner said M.I.T. had been warned to expect representatives of a generation containing "the most alienated and unhappy group of students of all time." Not so, as it turned out. "We have been tremendously buoyed up by the partnership and fellowship your presence has provided," Dr. Wiesner told the graduates.

His hope for them, he said, is that "with your special powers, you have also achieved a deep sense of love and respect for your fellow humans everywhere and in every station of life, and a determination to judge your personal accomplishments in terms of their welfare as well as your own."

Then came Dr. Wiesner's outspoken statement on government secrecy, communication, and information problems which appears on pages 15 to 17 of this issue of *Technology Review*. "The hoarding of properly public information is a major threat to the preservation of our free society," he said, "and its unavailability is a primary cause of much of the erratic and convulsive tenor of our time."

**Changes in the Calendar for 1975**

An innovation: the traditional Commencement Luncheon in the Great Court following the Graduation Exercises was abandoned for 1974, replaced by a reception on the Kresge Auditorium plaza. Tents were erected in which graduates of each of the five schools could greet their faculty and classmates, and President and Mrs. Wiesner met most of the graduates and their guests during a busy two-hour period.

More innovations next year. For the first time in many decades, the Graduation Exercises will be held on Monday instead of Friday—on June 2 in 1975. The purpose is to give the Registrar's Office more time to assemble and analyze students' records after the close of final examinations—and more time to notify students of the results.

A corollary change is that alumni re-

# Thoughts on Becoming "One of Us Now"

**Paul E. Schindler, Jr. '74**
**Contributing Editor, The Tech**

On May 31, 1974, by vote of the faculty of the Massachusetts Institute of Technology, I was awarded the degree of Bachelor of Science in Management, which puts a limited horizon on this column. As Chancellor Paul E. Gray, '54, pointed out during Tech Night at the Pops, "You're one of us now."

Being a one-week-old alumnus wasn't enough to get me a tennis court during Alumni Days, but it is already subtly altering my perceptions of the world. It has made me aware of two things: I have to turn my brass rat around so it is tail out, and I have to look for a permanent career. Let me assure you that I am keeping these two duties in a proper perspective.

Perhaps the greatest immediate, local disruption caused by Commencement was the 15-minute line outside Lobdell for breakfast (You're taking your parents HERE for breakfast?" one secretary asked) on Friday morning. But nobody was late getting out, and the graduates milled around outside du Pont in a rustle of wrinkled robes and hastily exchanged extra commencement tickets, while the parents sat in their cars in two slow lines extending back to Central Square and Back Bay.

It was hot and stuffy inside du Pont, but I was prepared to stand there for 10 or 15 minutes before the deadline because the instructions had said that the door would be closed at 10 and no one else allowed in to graduate. An alumni official assured me that this was an idle threat, so I managed to stay cool outside until exactly 10.

Inside, Sloan School undergraduates lined up in alphabetical order, exclaiming variously, "Who are you?" and "I didn't know he was a management major. . . ." The scene was undoubtedly being duplicated at all 27 stations in the gym, interfering—but only slightly—with the work of the monitors who struggled to keep everyone in line and in order. Our monitor, a short mustachioed fellow with a small green back-pack, had a fairly easy time of it, as most of Sloan majors seemed to know what alphabetical order was.

**"Do Not Shake the President's Hand"**

Finally, we marched in four columns into Rockwell Cage, accelerating remarkably at each long corner, resulting in the comical scene of 10 or 20 degree candidates jogging or dashing along to keep up with the stately academic procession.

All of us were careful to follow the stern warning of the "Instructions to Graduating Students" *not* to shake President Wiesner's hand as he gave us the diploma. Some did not stay behind the red line eight feet from the diploma rack, causing embarrassing pile-ups next to the President. One plucky lad had a Sync-sound Super 8 movie camera which he held at eye level as he got his degree, poking it into Dr. Wiesner's face and then aiming it at the audience as he left the stage, where several other people with super 8 cameras started following him.

Dr. Wiesner left the stage only once during the Commencement ceremony; that was to present a Master in City Planning to Charles A. Cofield, a young man whose confinement to a wheelchair made it impossible for him to get up on the stage. His thesis: "The Disabled Pedestrian: Human Factors."

After it was all over, as hundreds of us walked slowly around the lawn in front of Kresge introducing our parents briefly to each other and to our favorite faculty, it became clear why people without close family don't come to Commencement; what would they have to do?

unions, traditionally held prior to Alumni Days the week-end after Commencement, will be postponed until after Alumni Day which is tentatively set for Friday, June 6, 1975.

## Commissioning Exercises: 16 M.I.T. Men Join the Brass—"Something to be Respected"

Welcome to the establishment!

Welcome to the military-industrial complex!

Without them both, thinks Major General Benjamin N. Bellis, Commander of the Air Force Electronic Systems Division, the U.S. would be both poor and weak instead of strong and prosperous. Their reputation is "the key to our nation and what it stands for," and it will depend in part on *you:* 16 cadets from M.I.T.'s three R.O.T.C. programs who received Commissions at exercises on Thursday morning, May 30.

Welcome, too, as a member of the "brass," said General Bellis. "Leadership is something to be respected," he told the new officers, and "there is no more dedicated and honorable thing you can do; representing Uncle Sam is the highest responsibility an individual can have."

And finally, said General Bellis to the cadets as he prepared to present their commissions, you are joining "a peacekeeping establishment. . . . The best finding I could make as an officer would be that the military is superfluous, that I was out of a job."

*A proud moment before the Commissioning Exercises: James D. Cook, '74, enters a new career with his mother's blessing. (Photo: Edward J. McCabe, '75)*

Of the 16 cadets who received commissions in the annual exercises, the traditional opening of M.I.T. graduation events, two joined the Regular Army, five joined the Army Reserve, one joined the U.S. Naval Reserve, two joined the Regular Navy, and six joined the Air Force. Two cadets were listed to receive commissions following completion of summer training.

. . . a small class by anyone's count. But General Bellis pointed out that "M.I.T. has been a major element in the defense of our country, and you will help continue that tradition," he told the cadets.

## The Confluence of Nostalgia and Change: Alumni Days in 1974

College reunions are built on nostalgia, and M.I.T.'s 1974 Alumni Days had a quadruple serving of it: visiting with classmates, revisiting the campus, reliving days in Boston and the Boston Pops, and sharing those most romantic of technological artifacts—antique cars of appropriate vintage.

Over 1,200 alumni and their guests were in Cambridge on June 2 and 3 for all these adventures and many more. Rain which dampened reunions on Saturday reluctantly gave way to cloudy skies on Sunday and brilliant sun on Monday—a perfect day for dedicating the Great Court to one of M.I.T.'s finest leaders (*see above*) and for outdoor cocktails as a climax.

Even the speakers at the day-long symposium on "automobility"—a subject on which some discouraging news would hardly have been unexpected—had good tidings: the ubiquitous automobile, perhaps the device through which technology has most changed the world and man's ways of living in it, has as great a future as a past. Despite energy shortages and environmental constraints, said a series of 11 symposium speakers in Kresge Auditorium *(see page 52)*, the automobile's role as an integral part of American life and a vital unit of our transport and communications is assured. There will assuredly be changes, but "if our expectations can be realistic," said Professor John B. Heywood, Ph.D.'65, "technology has a lot to offer."

Automobiles were a theme throughout Alumni Days. Nine antique vehicles arrived at the Institute early Sunday afternoon, and uncounted alumni—and especially their offspring—were given tours of Briggs Field. You could ride in a 1917 Ohio Electric, a 1919 White bus (originally built to ferry tourists through Rocky Mountain National Park), "Fiedler No. 1," a 1937 Ford fire engine from Arthur Fiedler's collection, a 1929 Packard phaeton, a 1924 Packard roadster, an immense 1939 Duesenberg, or a tidy 1949 Ferrari—the second Ferrari convertible ever built. The cars were at M.I.T. through the courtesy of the Museum of Transportation in Brookline, Heritage Plantation of Sandwich, Mass., and members of the Veteran Motor Car Club of America.

### "A Special Place for Young and Old to Meet"

And three of these remarkable vehicles—the symposium made it clear that none like them will ever be built again—were at the center of the stage on Monday noon when William S. Edgerly, '49, President of the Alumni Association, called on representatives of the three principal reunion classes to report their gifts.

Leonard F. Newton, '49, reunion gift Chairman, left his coworkers surrounding the 1949 Ferrari and from the podium announced total giving of the Class of 1949 during the previous five-year period: $501,002 from 525 classmates; of the total over $228,000 had been raised within the previous 12 months. The gift, said Mr. Newton, is designated toward a visiting professorship, the full funding of which will be a continuing project of the class. The point, he said, is to help M.I.T. "maintain the excellence of teaching which is a hallmark of the Institute."

From the spacious compartment of the Duesenberg came Norman B. Krim, '34, to report for Frank R. Milliken, Reunion Gift Chairman; he brought President Jerome B. Wiesner eight "gold" bricks, symbolic of the Class gift of $393,000. Nearly 340 classmates' contributions were represented.

One of Edward J. Hanley's ('24) helpers labored to the platform with an oversize moneybag as Mr. Hanley was called from the 1924 Packard; the gag, Mr. Hanley said, contained a five-year gift of $670,357, the contributions of 312 members of the Class. A portion of it is designated for support of the Energy Laboratory as a Class project. (Later, at the reunion banquet in Plymouth, Chancellor Paul E. Gray, '54, commended the Class for "perceiving in M.I.T.'s Energy Laboratory a great new opportunity for the Institute to serve our society.") In addition, said Mr. Hanley, 26 members of the Class have made plans for future estate gifts to the Institute that have a current value of $1.631 million. It all would have been impossible, said Mr. Hanley, without the work of the late John F. Hennessey ('22), Mr. Hanley's predecessor as Reunion Gift Chairman.

Portions of these reunion gifts were included in the total of gifts to the 1973-74 Alumni Fund announced by Mr. Edgerly at the luncheon: $2.435 million, as of June 1. It was a sum "surpassing all previous records except last year's," said Mr. Edgerly—a not inconsiderable record considering the state of the economy, he thinks.

Responding to these announcements, President Wiesner said he wished that his "sense of gratitude . . . could be passed along to the thousands of alumni throughout the world who are not here, and whose generosity the gifts represent." It was, he said, a heartwarming demonstration of alumni banding together "to assure that new generations of students have opportunities to live productive lives" and to confirm "the value of diversity in our national life."

M.I.T. is "a special place for the young and old to meet," thought Dr. Wiesner—


*Reminiscences of all kinds were the order of the day on June 2 and 3 when more than 1,000 alumni and their guests returned to M.I.T. for Alumni Days. There were old cars to match the old grads—and to keynote the serious sessions on "automobility." Frank R. Shaw, President of his class, rode to Pops in a 1924 Packard, and earlier Howard W. Johnson, Chairman of the Corporation, had helped some younger guests to explore the delights of the same roadster (the car was from the collection of the Museum of Transportation of Brookline). "I'll tell you this story, but don't tell my wife!" a 50-year guest was overheard to tell admonish a classmate. And one of the younger visitors to the M.I.T. Historical Collections (above) asked his dad what V-12 meant; it turned out to be the World War II Navy training program of which his father was a member. (Photos: Sheldon Lowenthal, '74, Edward J. McCabe, '75, and Peter Buttner, '61)*


*Photographic recollections of Alumni Day do not all require explanation, but here are some clues to some of these: Luis A. Ferre, '24, receives his gavel as new President of the Alumni Association . . . his classmates, members of the Class Reunion Gift Committee, await the presentation of their $670,000 five-year gift . . . President Jerome B. Wiesner on the "Arthur Fiedler," a 1936 Ford fire engine from the maestro's collection . . . Dr. William Haddon, Jr. '49, President of the Insurance Institute for Highway Safety (below), and other members of the distinguished panel (lower right), at the Automobility" seminar. (Photos: Sheldon Lowenthal, '74)*

"the traditions of science and engineering confronting new views and new demands." He is sure that the future will be unlike the past, that problems will change in subject and scope, and that such changes will impose "a heavy burden on an institution such as ours.

"But our basic purpose should remain inviolate," said Dr. Wiesner: "to benefit mankind through science and technology."

**An Era of "Remarkable Transformation"**

For some visitors, Alumni Days on June 2 and 3 seemed more like the end than the beginning of the celebration. Some 1,000 alumni came to class reunions throughout New England on June 1 and 2—and only with some reluctance left their comfortable surrounds to attend events on the campus.

The largest—and longest—reunion was that of the Class of 1924, which chose for its 50th anniversary the Governor Carver Inn in Plymouth. The program began at 7 a.m. on May 31, when buses left for M.I.T. Graduation Exercises where the 50-year class were among the guests of honor. Later that day there was a luncheon tendered by the Council for the Arts at M.I.T. to honor the Class and especially its Luis A. Ferre, whose paintings were being shown in the adjacent Hayden Gallery. Then back to Plymouth for a day of recuperation.

It was Saturday evening when Paul E. Gray, '54, Chancellor of M.I.T., tried to put the Class' 50 years in perspective. "You graduated from high school," he said, "just as the Navy NC-4 flew the Atlantic," and flying around the world in 175 days was news in 1924. (Professor Jerome C. Hunsaker, '12, had designed the NC-4, and the round-the-world aircraft were the product of Donald W. Douglas, '14.)

Similarly "remarkable transformations" at M.I.T. in the same 50-year period, said Dr. Gray, because the country is now "at the threshold of a new era—one calling for a new concept of progress and a new level of judgment and understanding.

"We no longer can pursue a single enterprise without regard to its interaction, or even its collision, with others. . . . Our hope for the future lies in the intelligent and constructive use . . . of science and technology, and in a clearer understanding of the meaning and potential consequences of our efforts and an awakened moral and esthetic sensitivity in deciding our priorities.

"I believe we must now consider two mutually related cultures," said Dr. Gray. "One involves a scientific understanding of things; the second involves people—their history and their emotions."

**A Splash Party Rained Out**

For an observer of campus reunions, 1974 seemed to be a year of modest austerity—but not of lessened fellowship and warmth. Over 100 members and guests came to campus events of the Class of 1969—a splash party at the swimming pool to be followed by a picnic in the garden (torrential rain made the garden virtually a second swimming pool, and the picnickers found a remarkably comfortable refuge in the visitors' gallery of the pool) and a Saturday evening cruise in clearing weather on Boston Harbor.

Alumni Days was an integral part of the 25th anniversary celebration of the Class of 1949. Its 150 members and guests arrived on June 1, used campus recreational facilities on Sunday, and completed the celebration with a dinner-dance on Monday evening.

## A New President and His Colleagues: Objectives "Vital to Survival of Our Human Race"

He's been honored by the people of Puerto Rico and decorated by the King of Sweden, but Luis A. Ferré, '24, was far from untouched by his election as President of the M.I.T. Alumni Association. Receiving his gavel from William S. Edgerly, '49, at the Alumni Day luncheon, Mr. Ferré called M.I.T. "one of the most exciting and comprehensive centers of learning of the world.

"Having led the great technological revolution that has changed man's environment, M.I.T. has now broadened its objective to see that this revolution serves man toward the goal of a better and fuller life," he said. "I look forward to work . . . with this great faculty and their students for the achievement of these objectives which are vital to the survival of our human race."

Nine other alumni also assumed posts in the M.I.T. Alumni Association on July 1 as a result of the 1974 national balloting by 3,136 of their colleagues. They are:

—**Harl P. Aldrich, Jr.**, '47, President of Haley and Aldrich, Inc., Cambridge, Mass., member of the Board of Directors for two years, representing District 1.

—**John Blair**, '54, Corporate Director of Research, Raytheon Co., Lexington, Mass., Vice President for two years.

—**Charles Diebold, III**, '58, President and Chief Executive Officer of the Western New York Savings Bank, Buffalo, Vice President for two years.

—**Harry B. Duane, III**, '57, Executive Vice President of Norton Co., Worcester, Mass., member of the Board of Directors for two years, representing District 2.

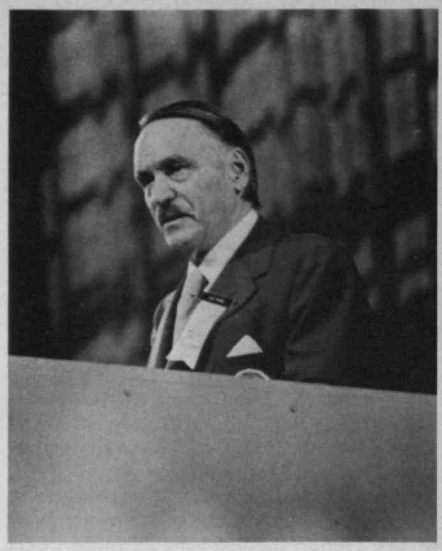
—**Reynold A. Grammer, Jr.**, '45, Project Engineer, Eastman Kodak Co., member of the National Nominating Committee for three years, representing District 3.

—**Otto E. Kirchner, Jr.**, '49, Unit Chief—Guidance and Control in the Engineering Department of Boeing Aircraft Corp., member of the National Nominating Committee for three years, representing District 9.

—**Gerald S. Kunstadter**, '49, Director of the Host Family Program, New York City Commission for the United Nations and for the Consular Corps, member of the Board of Directors for two years, representing District 4.

—**Jack C. Page**, '48, President of Jack C. Page, Inc., Dallas, member of the National Nominating Committee for three years, representing District 8.

—**James S. Rumsey**, '40, Vice President of Monkman-Rumsey, Wilmington, Del., member of the Board of Directors for two years, representing District 5.



*Having received his gavel as new President of the Alumni Association, Luis A. Ferré, '24, told his colleagues at the Alumni Day luncheon that "M.I.T. should have a closer and more dynamic rapport with its alumni." He seeks for them, he said, "a sense of pride and belonging that will enrich our lives by allowing us to contribute to the growth and strength of M.I.T." (Photo: Sheldon Lowenthal, '74)*

Mr. Ferré, the Association's new President, was elected to Life Membership in the M.I.T. Corporation in 1967; he was Governor of Puerto Rico from 1969 to 1972 and is now a director of nine companies in Puerto Rico and of the Luis A. Ferré Foundation. Mr. Ferré was decorated with the Order of the Vasa by the King of Sweden in 1958 to recognize his contribution to Puerto Rican industrial development.

## An Exhibition from Puerto Rico: Good Art that Remains Good

A major exhibition of rarely seen 19th-century paintings on loan from the Museo de Arte de Ponce in Ponce, Puerto Rico was Hayden Gallery's graceful compliment to the Class of 1924's 50th-anniversary celebration in June.

Through the efforts of its founder, former Governor Luis A. Ferré, '24, prominent Puerto Rican industrialist and patron of the arts, the Ponce museum has attained international stature for the quality of its collection since it opened in 1959. Now located in a modern building designed by Edward Durell Stone and inaugurated in 1965 (*see* Technology Review *for December, 1965, pp. 31-32*), the Museo de Arte de Ponce has amassed over 500 works representative of Western culture of the last five centuries, with particular emphasis on Renaissance, Baroque, 19th-century, and Puerto Rican art.

The 36 paintings in the Hayden show were chosen to clarify the complex esthetics of the 19th-century era. Eugene Delacroix, for example, was a progenitor of French Romanticism, and Gustave Mor-

eau, as the massive Moreau retrospective mounted by the Louvre a decade ago demonstrated conclusively, was a painter whose ideas and mystical explorations influenced a generation of better known artists.

In the introductory essay to the fully illustrated catalog of the exhibition (the catalog was published with the aid of a grant from the Council on the Arts), Bruce K. MacDonald, Director of Exhibitions at M.I.T., wrote: "It is just these artists who sought to express the visual poetry of their own era in its own terms . . . who have seemed most irrelevant and unimportant to the 20th century. For their contemporaries, however, they were the masters who most clearly reflected the comingled dreams and realities of the world that they shared."

Thus the exhibition offered a chance to reappraise the effect of such members of the French mainstream as Anne Louis Girodet-Trioson, Alexandre Gabriel Décamps, William Adolphe Bougereau, Jean Leon Gérôme. Masterpieces of the significant mid-19th century English Pre-Raphaelite Brotherhood include works by John Everett Millais, William Holman Hunt, and Sir Edward Burne-Jones, while Theodore Rousseau and Narcissus Diaz de la Pena provide superb examples of the Barbizon school. Francisco Oller y Cestero, a little-known Puerto Rican artist, reveals impressionist inspiration.

After exhibition at M.I.T., the show travelled to New York for six weeks at the New York Cultural Center. It represents an enduring principle: in Mr. Ferré's words—"Good art remains good, even when not in vogue."

## Awards for Engineering Innovations, Writing, Highways, and Women in the Professions

Spring is the season for prizes, and here are some noteworthy ones given at M.I.T. as the 1973-74 year ended:

**Music Selector, Torquemeter**

Eight undergraduates received cash awards totaling $950 for devising what appear to be marketable, socially relevant products in Eta Kappa Nu's first Student Innovation Contest. The funds come from the National Science Foundation through an innovation program under the direction of Yao T. Li, Sc.D.'39, Professor of Aeronautics and Astronautics.

There were two winners of first prizes ($300 each) because the judges could not choose between them: Carl N. Bielenberg, '74, and Rinaldo Spinella, '74. Mr. Bielenberg produced a combination recorder and phonograph turntable which can pick any selected song on part of a record in a stack of discs; a sensor determines where bands on a disc begin and end, and a computer "remembers" where the phonographic tone arm must move to pick up the required grooves. In two years of work in the Department of Electrical Engineering, Mr. Spinella produced a digital torquemeter which measures with great accuracy the amount of twist on a rotating shaft.

A third prize ($100) went to Albert Chin, '75, for a bicycle-powered snow vehicle, and Lee Laiterman, '77, won $50 for his entry—the only one from a freshman or sophomore—of a continuously-variable-diameter sprocket.

**Supersonic Shock Waves**

The 1974 student award of the New England Section of the American Institute of Astronautics and Aeronautics brought $500 to Woodrow Whitlow, Jr., '74, for an undergraduate research project on the effects of flow gradients on shock waves in supersonic flow.

Mr. Whitlow used a number of aerodynamic models in supersonic air flow in a wind tunnel and studied the resulting pressure waves; he thinks his results could have application in studies of the upper atmosphere and of the propagation of shock waves from supersonic missiles and aircraft.

**Computer-Aided Advertising**

The first Ernst A. Guillemin Prize for the best undergraduate thesis in electrical engineering has gone to Robert M. Elkin, '74, who described a computer-assisted system for laying out newspaper advertising. The award was $500.

Mr. Elkin first tested his computer-assisted program with the January 8, 1974, edition of the *Boston Globe*. Then he went to the offices of the *Worcester Telegram* to produce an advertising dummy of its March 8, 1974, edition in real time and in parallel with the manual layout operation. Professor David Adler, describing Mr. Elkin's work, reports that the new system "successfully positioned almost all the ads automatically in 20 minutes or less." It's a task which usually takes three hours or more, and Professor Adler expects that "newspapers will rapidly accept the use of on-line, interactive machines for the layout of display advertising."

There were two honorable mentions—to Philip W. Herman, '74, for a computer system for real-time control of experiments, and to Sheldon Lowenthal, '74, for his new design for a fluid-electric switch.

The Guillemin Prize honors the late Ernst A. Guillemin, '24, whose career in engineering education at M.I.T. spanned nearly 50 years. He was both beloved and admired as a teacher, strongly believing that students should be provided with a comprehensive background which would enable them to solve new problems of the future—not the problems of the moment. His subjects in network theory and electromagnetic field theory are remembered by every M.I.T. major in electrical engineering who graduated in the period of Professor Guillemin's active service.

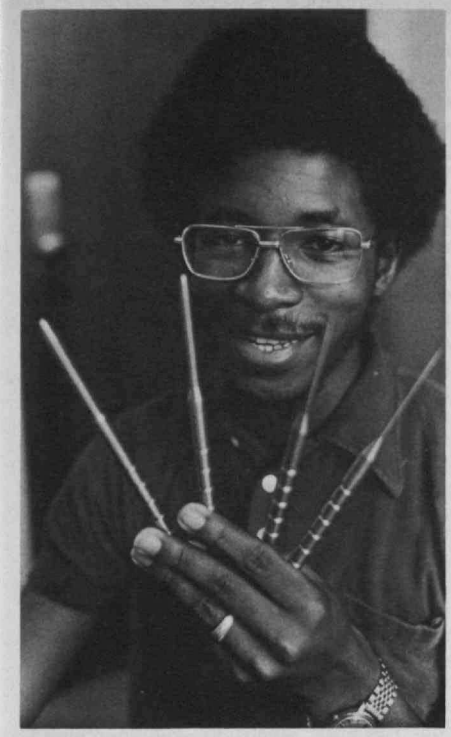
**Highways, Creativity, etc.**

Other prizes awarded as the academic year ended were:

—The Massachusetts Highway Association chose two M.I.T. students for $500 prizes to honor their interest and capabilities in transportation-oriented studies. The winners were Laurinda T. Bedingfield, '75, who is planning a career in highway construction management, and Michael G. Kozinetz, '75, whose interest is in highway design.

—Ilene S. Gordon, '75, is the first M.I.T. student to serve as a teaching assistant in the Andover Summer Session at Phillips Academy. Her appointment as one of 25 such teachers resulted from a na-

*Luis A. Ferre, '24, takes pride in his art and pleasure in showing it, so his Class Reunion at M.I.T. in June was a very special occasion: Outstanding paintings from his collection were on display in Hayden Gallery, his reunion classmates and their guests were obviously enthusiastic in their viewing of it, and Mr. Ferre was delighted with every opportunity to describe his works (right).*



*These aerodynamic models, representing different shapes for the borebodies of supersonic vehicles, were used by Woodrow Whitlow, Jr., '74, in research on how changes in air pressure distribution affect shock waves and sonic booms. His studies were good enough to win for him the 1974 Student Award of the New England Section of the American Institute of Aeronautics and Astronautics, including a $500 prize.*

tional competition in which more than 500 college students participated.

—Two M.I.T. coeds are working this summer under internships in the "Women and Career Options" project of the Carnegie Corp. Judith A. Ellenson, '74, is working at the Charles Stark Draper Laboratory, examining the role of women in a computer programming environment; and Sharon Bernstein, '77, is at work in the Dean's Office in the Sloan School of Management, studying management as a profession for women.

—Summer writing grants, awarded to help students pursue "serious writing projects" during the summer, have gone to six undergraduates. They are: Anne McKinnon, '75, $800 for a collection of poetry; Marth S. Sasaki, '76, and Michael P. Thomas, '74, $1,000 for a joint project of photography and poetry; Anthony P. Cortizas, '76, $800 for a novel; Alexander R. Jones, '74, $800 for a novel; and Michael W. Gilbert, '76, $200 for a short novel.

—Three Luis de Florez ('11) Awards for creative undergraduate design projects in mechanical engineering have been given to Gordon O. Salmela, '74, for a rotary rolling conduit designed for the Ainslie Corp.; Marc J. Rosenbaum, '75, $400 for the design and construction of an ultralight track bicycle; and James B. Cook, '75, and Roy F. Greenwald, '75, $300 each for a wire-skiving gage.

## Research on Research: Will Assessment Lead to Abridgement?

If a nation must try to assess the social and environmental implications of a new technology before exploiting it, does not a faculty have a similar responsibility for the impact of the new knowledge it creates?

Professor Philip Morrison's concern for the question stemmed originally from his fear that successful missile guidance research at M.I.T. might destabilize the relationships between East and West; should an educational institution undertake work which might have this fearful result? he asked the M.I.T. faculty in May, 1970 *(see October/November, 1973, pp. 94-97).*

By September, 1973, the faculty had before it a proposal for a standing committee "to estimate the impact of campus research projects on national security, the physical environment, and other aspects of the social welfare."

A broad mandate, embedded in quicksand.

Could it work? No one was sure; hence another faculty committee to study implementation, appointed in October, 1973. This June its chairman, Professor John M. Deutch, '61, of the Chemistry Department, returned with his committee's dilemma:

"A reasoned and moral stance would require a serious, organized, persistent effort to tell ourselves and our community—eventually, all who wish to know—what may happen as a result of our own work," he read. But can M.I.T. pretend that a committee of its faculty will succeed in assessing the social impact of research—a task which to date has defied even specialists in technology assessment. And should a faculty or its committee, sitting in judgment, take "steps that might lead to intervention in the freedom of inquiry at M.I.T."?

Not able to resolve their "widely divergent" views on this question, Professor Deutch and his committee concluded to give the faculty an opportunity for discussion and expression by moving a new faculty committee on the Impact of Research "to apprise the faculty of the impact of M.I.T. research and to enhance our understanding of the wider impacts of research and development . . ." The Committee would help individual faculty members prepare statements—if they were interested in doing so—of the impact of research which they proposed to launch; but such statements would be optional. It would report to the faculty, but the Committee would have no authority to delay or prohibit any project.

Professor Morrison spoke eloquently on the issue: "A university faculty is part and parcel of a complex society," he said, "and it does not have the luxury of being cut off from the consequences of its research."

But Professor Eugene B. Skolnikoff, '49, who as Director of the M.I.T. Center for International Studies is a student of science and public policy, found himself uneasy. The faculty committee, he feared, underestimated the problems of technology assessment and its impact.

If for example a faculty member chose not to write an impact statement, he asked, would not that in itself be construed by some as a sign of weakness in his research proposal?

Professor Skolnikoff's alternative: pick a few research topics for intensive study during the next two years, "to see how far we can go down the road of assessment," to seek methods and discover pitfalls.

To a faculty steeped in the value of experiment this seemed a better route; the proposal for a committee went down to a modest defeat, 34 to 55; and Professor Skolnikoff pledged to return with a research proposal early in the new academic year. And for himself, President Jerome B. Wiesner pledged his support for some expression of research assessment. It is not, he said, "an issue which should be dropped with this vote."

## The Squeeze on Activities; or How Finboard Fights Inflation

The classic dilemma: "We had twice as many applications for funding this year as we did last year," Jack A. Van Woerkom, '75, Chairman of the Undergraduate Finance Board ("Finboard"), told Paul E. Schindler, Jr. '74, of *The Tech* this spring. "But we only received the same amount of money to distribute."

As a result Finboard's 1974-75 activities budget, prepared this spring, shows "unallocated reserves" of only $2,000, down from $9,185 a year ago. "We had to do a lot of budget-cutting to have $2,000 left over," said Mr. Van Woerkom. "It is going to make things really tight this year."

Or even worse, thinks Mr. Van Woerkom, because unallocated reserves are used at the discretion of Finboard to help student activities with unexpected needs during the term. If, for example, the Debate Team wins the right to go to the district tournament next year and Finboard is out of unallocated money, "we just won't be able to help them."

The largest discontinuity in the budget was Urban Action—student-sponsored activities related to problems in Cambridge and Boston. Urban Action lost its funding from the Community Service Fund in 1974 and now is considered defunct.

## Board and Room Sharply Up, But No "Mass Exodus" Foreseen

Room and board rates in M.I.T. houses will be up next year—an average of just under 18 per cent for room rents and 14.4 per cent for board. The increases, stemming from the rising cost of fuel and light (in the case of the room rents) and of food and labor (in the case of board), are "more than any of us would have liked," H. Eugene Brammer, Director of Dining and Housing, told *The Tech*.

But inflation is inexorable. The price of heat supplied to the houses is up 121 per cent in two years, electricity up 64 per cent, and food up 20 per cent, according to Mr. Brammer; and he thinks a further increase of 15 per cent in food cost is possible before the end of 1974-75.

The new increases put room rents in the range from $792 to $1,018 for the year. In general, rooms in Senior House and Bexley Hall are least expensive; then come, in order, East Campus, Baker House, Burton House, McCormick Hall, and MacGregor House.

The "commons" meal contract for next fall's term, providing 15 meals per week, will be $370, compared with $325 for 1973-74. But there will be two new options: a 19 meal-per-week option (adding brunch and dinner on Saturdays and Sundays) for $480; and a 25-day ticket good for 25 breakfasts, 25 lunches, and 25 dinners any time during a term, for $145.

Why is food service so high at M.I.T.? Because, Mr. Brammer told *The Tech* this spring, the dining halls are underutilized. M.I.T. has no compulsory dining for students, and many houses provide kitchens in each suite of rooms. The result is that present facilities and staffs could take care of several hundred more customers than they have.

Will the higher costs force students out of the dormitories? No "mass exodus," thinks Kenneth C. Browning, '66, Assistant Dean for Student Affairs. "I'd really be surprised if many people moved out because of this." Instead, he expects overcrowding because of the larger number of freshmen to register in the fall. James A. Moody, '75, Baker House representative on the student committee which reviewed the new rates before they were announced this spring, agrees: "Apartments and the cost of living in general will be going up, too," he told Michael D. McNamee, '76, of *The Tech*; "it won't be that much more attractive to move off."

A somewhat different speculation occurred to Storm R. Kauffman '75, of *The Tech*. House bills in M.I.T. fraternities may average $160 a month next year—perhaps $200 a year less than the cost of rent plus "commons" meals for dormitory residents. Though fraternity capacity is fairly static, Mr. Kauffman thinks "the houses are increasing their economic edge for the Class of 1978 rush."

**Following is the 1974-75 budget showing allocations to student activities by the Finance Board of the Undergraduate Association:**

| | 1973-74 | 1974-75 |
|---|---|---|
| African Student Association | $ 600 | $ — |
| Automobile Club | 100 | 100 |
| Bridge Club | 100 | — |
| Black Students Union | — | 440 |
| Chinese Students' Club | — | 400 |
| Dance Workshop | 375 | — |
| Debate Society | 800 | 800 |
| Ecology Action | — | 200 |
| Electronic Research Society | 430 | 150 |
| Logarythms | — | 100 |
| Minority Arts | — | 380 |
| MITV News | — | 1,080 |
| Pershing Rifles | 150 | 105 |
| Plant Club | 50 | — |
| Right to Choose | 310 | 500 |
| Rocket Society | 350 | 320 |
| Science Action Coordinating Committee | — | 280 |
| Science Fiction Society | 250 | 990 |
| Strategic Games Society | 120 | 70 |
| Student Homophile League | — | 350 |
| Technology Community Association | 7,535 | 10,000 |
| Tiddlywinks Society | 50 | — |
| Tropical Plant Club | 75 | 145 |
| Urban Action | 4,000 | — |
| W1MX | — | 225 |
| WTBS | 7,000 | 9,880 |
| **Total activities allocations** | **$22,295** | **$26,515** |

## New Grants from the Council for the Arts: $28,650 to 10 Programs

Grants totalling $28,650 have been made by the Council for the Arts at M.I.T. to ten art-related activities; they bring to just over $51,000 the total of Arts Council funding to more than 20 M.I.T. projects.

The new grants are:

—$3,500 for an arts facilities study under Donlyn Lyndon, Head of the Department of Architecture.

—$6,000 to the Visible Language Workshop, a collaborative enterprise among the Departments of Humanities and Architecture, the M.I.T. Press, and the Center for Advanced Visual Studies.

—A matching grant of $1,500 to a seminar on "Art and Architecture in the Service of Politics" under Henry Millon, Professor of History and Architecture, partly to allow publication of papers presented by invited scholars.

—$2,500 to Professors Richard Leacock and Edward Pincus of the Department of Architecture to create a 16-mm. traveling film package of work by the students and faculty of the Film Section.
—A matching grant of $1,250 to Dean Harold Hanham of the School of Humanities and Scoail Science for a survey of drama at the Institute.
—$500 to Hans Guggenheim, Research Affiliate in Architecture, to prepare a public lecture on Tellem art arising from his trip with M.I.T. students to Mali in January, 1974.
—$10,000 to the Music Section of the Department of Humanities to purchase six pianos for practice rooms now under construction.
—$500 to photographer Minor White to prepare an exhibition in M.I.T.'s main entrance lobby of work by M.I.T. students in the collaborative photographic project in Rome during the Independent Activities Period in January, 1974.
—$400 to composer Paul Earls, fellow at the Center for Advanced Visual Studies, for a large-scale musical performance to be presented by the Glee Club, the Concert Band, chamber groups, and soloists in M.I.T.'s main entrance lobby.
—$2,500 to the Committee on the Visual Arts for publication of a catalogue accompanying the exhibition in Hayden Gallery of works from the Museo de Arte de Ponce, Puerto Rico.

## "Doing" Engineering: A Dramatic Increase in Cooperative Programs

New affiliate companies and sharply increased enrollments mark a "dramatically upward trend" in three cooperative programs in the M.I.T. School of Engineering.

(Students in cooperative programs spend two or more terms during their undergraduate years working at one or more companies on research, development, or management tasks; they graduate in the normal four years by using their sophomore and junior summers as extra terms. Many choose to remain in the programs an additional year to receive S.M. and S.B. degrees simultaneously.)

There were 116 applicants for the cooperative program in electrical engineering this year—up from 39 just four years ago; 60 students have been accepted, the largest class enrolled since 1956.

Fairchild Camera and Instrument Corp., a leading company in the semiconductor field, has been added to the 14 firms which took M.I.T. students in 1973-74; and Digital Equipment Corp., which first took Course VI-A students only in 1972, will have 12 students working in 1974-75.

Applications for the cooperative program in the Department of Ocean Engineering were up 50 per cent this year—a "dramatically upward trend," says Chryssostomos Chrysostomidis, Ph.D.'70, Assistant Professor of Naval Architecture. And two new companies have agreed to take Course XIII-C students next year: Avondale Shipyards of New Orleans and the American Bureau of Shipping in New York.

A similar growth of interest is affecting the Department of Mechanical Engineering's Course II-B; plans are being made with Cambridge Collaboratives, Inc., 3M Companies, and the U.S. Army Transportation Corps to employ students, and

*"Just as it was possible to add dimension by artful design to the portrayal of the female symbol, so should it become increasingly possible for women to add depth to their lives by considering careers in technology or science," says Edith Ruina, editor of the newly released M.I.T. booklet, "Women in Science and Technology, A Report on an M.I.T. Workshop." She and Laya Wiesner, Ms. Ruina's partner in the presentation of the workshop, display their cover design.*

*Publication of the booklet brought the two women invitations for interviews from* Vogue, Parents, Business Week, Good Housekeeping, *and the UPI and AP news services. Ms. Ruina comments on the diversity of response: "Clearly the pamphlet resonates with the concerns of a very broad population. Inquiries have come about it from parents, employers, and educators all over the country."*

*The booklet is available for $2.00 from the M.I.T. Press.*

Stanley Backer, '41, Professor of Mechanical Engineering, has invited a number of other firms to join the program, anticipating an increase in the number of interested students.

John A. Tucker, Director of the Department of Electrical Engineering cooperative program (Course VI-A), thinks the new interest in learning-while-doing reflects "the improvement in the outlook for engineering. . . . M.I.T. students generally are showing increasing interest in 'doing' engineering," and don't discount the opportunity which a cooperative program affords for earning while learning, he says.

## Electrical Engineering: Diversity, Good Teaching, and Getting Involved

*The Department of Electrical Engineering is M.I.T.'s largest, and people are fond of noting that it is in fact larger than many an independent college. Hence the interest at the Institute in the views of its new Head, Wilbur B. Davenport, Sc.D.'50, who assumed that post early this year. Here are excerpts from an interview conducted by Paul E. Schindler, Jr., '74, Contributing Editor, published in* The Tech *early this spring:*

*Schindler:* Why is electrical engineering the largest department in the Institute?

*Davenport:* History. Two kinds of history. One is that the Department, certainly since I've been around, has been remarkably flexible in terms of its intellectual areas. In a number of these areas it has been a national leader. The range of different things going on has attracted many of our graduate students. After talking with a number of undergraduates at the time of decision—when they are choosing their major field—I judge that seemed important to them too.

The other issue mentioned by undergraduates is the fact that this is a "good teaching department."

*Schindler:* Why? What does that mean?

*Davenport:* I came here first as a graduate student and a teaching assistant, so I've been involved in teaching here as long as I've been on campus. It was certainly impressed on me when I came here that the Department considered it important that I be involved in undergraduate teaching and counseling. Every department head and executive officer I've dealt with since I arrived took the position that that was something important for me to do as a member of the teaching staff.

*Schindler:* How heavy is the electrical engineering teaching load?

*Davenport:* As much as possible, our faculty is involved, every member, in undergraduate teaching, graduate teaching, thesis research, and personal research. That may not all be done at the same time. A member of our faculty may teach an undergraduate subject one term and a graduate subject the next term. That's a fairly standard pattern. There are a few who, for various reasons, will concentrate at either the graduate level or undergraduate level. But we feel very strongly as a department that there should not be a graduate faculty separate and distinct from the undergraduate faculty.

*Schindler:* Would you like to see students in electrical engineering working at co-op jobs that are social or political as well as electrical?

*Davenport:* If I thought they would learn something from it and contribute to it, I would say absolutely, even if it is not directly related.

That's probably one of the strongest feelings I have. If you ask the next question: How to implement that, you face other questions. How do you make the overall educational system at the undergraduate level something that achieves your objectives and still doesn't cost itself out of existence?

There's a lot of rhetoric around the country about the use of technology in education. I think we have a lot to learn. I do not think it is true that anyone, either here or elsewhere in fact, knows a good way, let alone the best way, to use technology in education. I think we have to experiment.

The question we have to face is: What is the best way to attack the presentation of the technical material that we want our students to get, at the same time giving them some experience at making use of some of the other ideas they should be getting out of their education, ideas about the human side of engineering, and the world they live in?

*Schindler:* What are the future growth areas in electrical engineering?

*Davenport:* It seems that the interaction of information processing and computer science with other fields that use the words control and communications—transportation, medical services, etc.—is a subject that needs to be worked on. It seems inevitable that this Department will be increasingly involved. We are already involved in parts of these areas. Our involvement in these interconnections will become greater as time goes on.

I think we have to do it in such a way that we don't lose sight of the fact that the technical systems we are concerned with, such as computer systems themselves, communications control, etc., depend on a detailed understanding of the devices and the physical phenomenon involved.

The day the Department loses sight of the fact that major changes of our views of the world, the way we look at it and describe it, have very often been coupled to what we can build, what we can work with—on that day we'll lose something important.

I'm not a computer scientist, but I have been around the periphery of the field for years, and its very interesting to see how the views of what you can and can't do evolve with the state of the art in memory and devices. The change from relays to vacuum tubes to transistors to integrated circuits to large-scale integrated circuits made profound changes in what you're willing to concede can be done. The change from core to active memory enables you to have relatively cheap very large memories and very fast devices. You suddenly find yourself thinking of things you want to do that you didn't think of before.

*Schindler:* What do you see ahead for the Department?

*Davenport:* Some time ago, one of the things that disturbed me was that a number of our seniors got to graduation time and in fact didn't really know any of our faculty on a close basis. I've also been concerned over a somewhat different issue—that, while we have undergraduate and project laboratories as well as an undergraduate thesis, those undergraduates who are not in the co-op program have a minimal contact with the doing of engineering, in contrast to studying about the doing of engineering.

I would like to see our education have students more involved with the doing of technical work. I am not talking just about the doing of home problems. I'm talking about getting into situations where part of the problem is the definition of the problem, getting involved with problems where there isn't a single simple answer—where there are a multiplicity of answers—and one of the things you have to do is to decide which of the solutions you want to go to. You have to start worrying about the boundary conditions of the problems. Sometimes they are technical, sometimes they are legal, sometimes they are social.

## A Retired University President, A Leading Statistician, Among 12 New Faculty

Twelve appointments to the M.I.T. faculty have been announced during the spring:

—**Tanya M. Atwater**, Assistant Professor of Earth and Planetary Sciences, has come to the Institute from a similar post at Scripps Institution of Oceanography, part of the University of California (San Diego).

—**Jeanne S. Bamberger,** formerly Research Associate in Electrical Engineering, has been named Associate Professor of Education and of Music. She has been at M.I.T. since 1971, working in the Artificial Intelligence Laboratory on the perception of music and, more recently, in the Division for Study and Research in Education. Her book, *The Art of Listening,* is widely used as an introductory college music text.

—**Herman Chernoff**, considered one of the world's distinguished scholars in the field of statistics, has joined the Institute as Professor of Applied Mathematics; he is beginning organization of a new program in statistics in the Department of Mathematics. Most recently Chairman of the Department of Statistics at Stanford University, Dr. Chernoff studied at City University of New York and Brown University; his work with the Cowles Commission at the University of Chicago helped to set the foundations for estimation techniques in the field of econometrics.

—**Michael L. Fredman,** instructor in mathematics, became Assistant Professor of Mathematics on July 1. He studied at California Institute of Technology (B.S. 1969) and Stanford (Ph.D. 1972), and then came to M.I.T. for research and teaching in computer science and combinatorics.

—**Thomas F. Jones**, Sc.D.'52, will return to M.I.T. for 1974-75 as Visiting Professor of Engineering and Education.

*T. F. Jones*

*M. Weiner*

*J. G. King*

*A. Rich*

*I. D. Turner*

A distinguished engineering educator, Dr. Jones left M.I.T. in 1958 to become Head of the School of Electrical Engineering at Purdue University; he will retire this summer after 12 years' service as President of the University of South Carolina—to which he will return as Distinguished Professor in 1975. Professor Jones was a member of the National Science Board from 1966 to 1972 and President of the Southern Association of Land-Grant Colleges and State Universities in 1969-70. At M.I.T. next year he will work with the Center for Advanced Engineering Study and the Division for Study and Research in Education.

—**Donald R. Lessard**, formerly Visiting Assistant Professor, has been named Assistant Professor of Management in the Sloan School. A native of California, Professor Lessard was educated at Stanford (A.B. 1965, M.B.A. 1969, and Ph.D. 1970) and taught in the Amos Tuck School of Business Administration at Dartmouth from 1969 to 1973.

—**Peter Molnar**, formerly Assistant Research Scientist at the Scripps Institution of Oceanography, is now Assistant Professor in the M.I.T. Department of Earth and Planetary Sciences.

—**Bryan R. Pearce,** '66, Research Associate, has been named Assistant Professor of Civil Engineering. He joined the Department's research staff in 1972, following completion of his Ph.D. at the University of Florida.

—**Cho K. Rha** has been named Associate Professor of Food Process Engineering in the Department of Nutrition and Food Science; she came to the Institute from the Department of Food and Agricultural Engineering at the University of Massachusetts, Amherst, where she was Assistant Professor of Food and Biological Process Engineering.

—**Keith D. Stolzenbach**, '66, will join the Department of Civil Engineering as Assistant Professor on July 1; he is presently associated with the Division of Water Control Planning of the Tennessee Valley Authority, Norris, Tenn.

—**Shin Takauchi,** Associate Professor at the Institute of Solid State Physics at the University of Tokyo, will be Visiting Associate Professor of Mechanical Engineering for 1974-75. A University of Tokyo graduate, Dr. Takauchi will participate in M.I.T. research on the plasticity of metals and compounds.

—**Paul S. H. Wang,** Ph.D. '71, instructor in mathematics, has been appointed Assistant Professor of Mathematics effective July 1. Professor Wang has been associated with Project MAC since coming to the Institute, and his teaching will be in the field of computer science and applied mathematics.

## Myron Weiner Heads Political Science: Can We Teach Politics to Scientists and Engineers?

Myron Weiner, who has been Professor of Political Science and a senior staff member of the Center for International Studies since 1965, is now Head of the Department. He succeeds Professor Eugene B. Skolnikoff, '49, who will continue as a member of the Department and as Director of the Center for International Studies.

Harold J. Hanham, Dean of the School of Humanities and Social Science, assured *The Tech* that Professor Weiner's appointment—which is for three years with the possibility of renewal thereafter—"would be received with general acclaim." Indeed, *The Tech* was told anonymously that "no one else was seriously considered for the post."

Professor Weiner told *The Tech*'s Michael D. McNamee, '76, that "curricular development" will be "the most important thing in the Department in the next few years." He hopes especially to serve "the majority of M.I.T. students who are primarily scientists and engineers but who might need to know about politics . . . a growing number of students . . . who are going into public service of one sort or another." But the Department's graduate and undergraduate majors are regarded as its "basic constituencies."

Professor Weiner's current research deals with the political consequences of migration in underdeveloped societies; he has done extensive research on political change in developing countries, especially India, and he is Chairman of the National Academy of Sciences' Project on Population Policy in Developing Countries.

A graduate of City College of New York (B.A. 1951), Professor Weiner studied at Princeton (M.A. 1953, Ph.D. 1955) and taught at Princeton and the University of Chicago before coming to M.I.T. in 1961.

## Three Professorships: Physics, Biology, and Self-Help Housing

Three members of the M.I.T. faculty have been honored by appointments to distinguished professorships:

—**John G. King,** '50, Professor of Physics, is the first Francis Friedman Professor, a chair created to honor the memory of Professor King's former colleague who died in 1962. The Professorship is an outgrowth of the Francis Friedman Lectureship, created shortly after Professor Friedman's death by a gift from his family to honor the outstanding faculty member who was especially beloved as a teacher; now an additional gift has been made by the O.F. Foundation.

Professor King worked closely with Professor Friedman in the decade before the latter's death, and they are together identified with the Physical Science Study Committee's high school physics curriculum and with the early work of the M.I.T. Science Teaching Center. Since then Professor King has maintained his interest in educational innovations, and he holds the Robert A. Millikan Award of the American Association of Physics Teachers and a Harbison Award of the Danforth Foundation. Professor King has been a member of the staff since completing his Ph.D. in physics in 1953; his research has been in several areas of experimental atomic physics, and his current efforts are devoted to developing a "molecular microscope."

—Dr. **Alexander Rich,** Professor of Biophysics, has been named to succeed Dr. Salvador E. Luria as William Thompson Sedgwick Professor; Dr. Luria is now Director of M.I.T.'s Center for Cancer Research.

The Sedgwick Professorship, created in 1964, honors the first Head of M.I.T.'s Biology Department, a distinguished teacher and student of bacteriology and public health. Dr. Rich, whose undergraduate, graduate, and medical degrees are from Harvard (M.D. 1949), is described by Robert A. Alberty, Dean of the School of Science, as a "major contributor to our knowledge of the molecular structure of biological materials, notably nucleic acids and proteins." His work with x-ray diffraction analysis has led to an understanding of three-dimensional structure of the transfer

RNA molecule to a resolution of 3 × $10^{-10}$ meters. Before coming to M.I.T. in 1958 Professor Rich was Chief of Physical Chemistry at the National Institute of Mental Health; he had done postdoctoral work at the California Institute of Technology (1949 to 1954) and the Cavendish Laboratory, Cambridge, England (1955 to 1956).

—**Ian D. Turner,** Associate Professor of Planning, has been appointed to a Career Development Professorship under a 1966 grant of the Ford Foundation for the support of international studies in political science, economics, management, and urban planning.

Since coming to M.I.T. in 1972, Dr. Turner has concentrated his research and teaching on "self-help" housing and housing policy—systems by which tenants themselves plan and build or rehabilitate the building in which they will live. The field is "of major significance for developing countries," says William L. Porter, Dean of the School of Architecture and Planning, hence the Ford International Professorship to Dr. Turner.

Dr. Turner's degrees (A.B. 1961, M.C.P. 1964, and Ph.D. 1972) are from Harvard. He is a partner in Massdesign, Architects and Planners, Inc., of Cambridge and chairman of a committee on self-help rehabilitation of abandoned buildings of the Cathedral of St. John the Divine in New York.

## Space Research Director; Materials Science Assistant Directors

Three members of the M.I.T. faculty have new administrative responsibilities in interdepartmental laboratories:

—Merton C. Flemings, '51, ABEX Professor of Metallurgy, has been named Assistant Director of the Center for Materials Science and Engineering.

—John F. McCarthy, Jr., '50, Professor of Aeronautics and Astronautics, is Director of the Center for Space Research.

—Peter A. Wolff, Professor of Physics, is Assistant Director of the Center for Materials Science and Engineering.

The two appointments in the Center for Materials Science and Engineering are designed to broaden its scope by bringing workers in both metallurgy and physics into more active roles, says Nicholas J. Grant, Sc.D.'44, Director of the Center. Dr. Wolff is head of the Solid State and Atomic Physics Division of the Department of Physics, and Professor Flemings is leading a program to develop automated processes for the manufacture of steel castings.

Professor McCarthy, who was Vice President—Systems Engineering at North American Rockwell before returning to M.I.T. in 1971, succeeds Professor John V. Harrington as Director of the Center for Space Research. Herbert S. Bridge, Professor of Physics who has been Acting Director of the Center since 1973, will remain as Associate Director; Professor Harrington is on leave to serve as Vice President for Research and Engineering at the Communications Satellite Corp.

## Eleven Faculty Retirements; Revered, Familiar Names Led By Weisskopf, Locke, White

The retirement of eleven members of the M.I.T. faculty was announced in Cambridge as the 1973-74 term ended; all have made distinguished contributions to the Institute and the professions in which they worked. They are:

—**Douglas P. Adams**, Professor of Mechanical Engineering, came to the Institute to teach engineering drawing and graphics in 1938. He has extended this work into kinematic analysis and synthesis and has recently pioneered in the development of nomography—graphical methods for solving static and dynamic engineering problems—and in the application of computers to such systems. Professor Adams is also widely known for his interest in the history of Greater Boston, a subject to which he has introduced many students and to which he has made important contributions. Professor Adams holds degrees from Harvard College (S.B. 1930) and Harvard Law School, and he is a member of the Massachusetts bar.

—**Lynwood S. Bryant**, Professor of History, is known for studies in the history of technology and for his early leadership of the M.I.T. Press, of which he was Director from 1957 to 1962. He came to M.I.T. in 1937, just before completing his A.M. degree at Harvard University; he was a member of the Class of 1929 at Harvard College. His teaching at M.I.T. has recently included subjects in the history of transportation of the automobile, and of American economic institutions. Professor and Mrs. Bryant shared the duties of Master of McCormick Hall from 1963 to 1967, where they contributed much to M.I.T.'s first residence hall for women.

—**Margaret Z. Freeman**, S.M.'31, Associate Professor of Russian, designed M.I.T.'s language laboratory which later became a model for many school systems, and she initiated the first Russian course at M.I.T. An emigre from prerevolutionary Russia, Mrs. Freeman lived much of her young life in Harbin, Manchuria, where she graduated from the Polytechnic Institute in engineering. She joined the teaching staff at M.I.T. after receiving her master's degree here, and she has devoted special attention to women undergraduates, freshman advisers, and project research for the Provost.

—**Myle J. Holley, Jr.**, '39 Professor of Civil Engineering, returned to the Institute in 1946 for graduate work from a post as Assistant Chief Engineer for the S. Morgan Smith Co. of York, Pa. He joined the faculty in 1947 upon completion of his S.M. degree, and he has since made significant contributions through teaching and research to the theory and practice of structural engineering—particularly the design of reinforced concrete structures.

—**William N. Locke**, Foreign Study Adviser, has had a many-sided career during 30 years at M.I.T. He came to the Institute in 1945 to head the Department of Modern Languages, and his work during the period 1945 to 1956 represented significant contributions to the fields of speech analysis and machine translation of languages. Professor Locke continued these interests following his appointment as Director of Libraries in 1956—and expanded his work to include computerized library services; he retired as Director of Libraries in 1972. Professor Locke is a graduate of Bowdoin College (B.S. 1930) and of Harvard (A.M. 1937, Ph.D. 1941).

—**Victor P. Starr**, S.M.'38, Professor of Meteorology, is a recognized authority on the circulation of planetary atmospheres and the author of a theory of negative viscosities from which has come a clearer understanding of the earth's general atmospheric circulation. Professor Starr came to M.I.T. in 1937 after studying at New York State University (A.B. 1930), and he joined the M.I.T. faculty in 1947 after completing graduate work at the University of Chicago (Ph.D. 1946).

—**George E. Valley, Jr.**, '35, Professor of Physics, made early contributions to computer-processing of radar data as Associate Director of Lincoln Laboratory (1953 to 1957) and later as Chief Scientist for the U.S. Air Force. His interest in undergraduate education resulted in his ap-

*The happy man in the middle is Charles S. Draper, '26, Institute Professor Emeritus who is founder and now Senior Scientist of the Laboratory that bears his name. He's receiving from its authors the first copy of* Magnetic and Electric Suspensions, *published by the M.I.T. Press; it's the first hard-cover book to come from the recently incorporated Draper Laboratory. Others, from left to right in the picture, are the three authors, all members of the Draper Laboratory staff: George A. Overbeck, Richard H. Frazier, '23, and Philip J. Gilinson, Jr., '36; and Alexander Kusko, Sc.D.'51, the editor of the Engineering Technology Series of which the new book is a part. Mr. Frazier, the senior author, is Senior Consultant to the Draper Laboratory and Emeritus Professor of Electromechanics at M.I.T.; the book grows out of work which he has led in the Draper Laboratory over the past 20 years.*

pointment as Undergraduate Planning Professor in 1965, and he has most recently been identified with the Experimental Studies Group, an alternative program for M.I.T. freshmen. Dr. Valley first came to the M.I.T. staff in 1941 to work in the Radiation Laboratory, and he was appointed to the faculty in 1946; his graduate degree is from the University of Rochester (Ph.D. 1939).

—**George P. Wadsworth**, '30, Professor of Mathematics, retires after 40 years on the M.I.T. teaching staff—a career which began even before he completed his graduate work at the Institute (S.M. 1931, Ph.D. 1933). His work in applied mathematics and operations research contributed significantly to the late Norbert Weiner's classic theory on generalized harmonic analysis and provided the basis for understanding complex phenomena within the areas of meteorology and seismic exploration. For many years Professor Wadsworth was responsible for the entire advisory function for undergraduates in the Department of Mathematics.

—**Victor F. Weisskopf**, Institute Professor (Physics), is a giant among physicists, formerly Director General of the European Center for Nuclear Research (CERN) in Geneva, Switzerland, and Head of the M.I.T. Department of Physics. A theoretical physicist, he has written distinguished papers in nuclear physics, quantum theory, and radiation theory; and he has also made important contributions to defining the significance of physics among the sciences. A native of Vienna, Dr. Weisskopf's Ph.D. degree is from the University of Gottingen (1931); he has been at M.I.T. for 28 years, Institute Professor since 1971, and Killian Lecturer for 1973-74.

—**Donald Whiston**, '32, Deputy Director of the Physical Plant, has brought to his assignment a background of training in building engineering and construction at M.I.T. and of teaching and professional work in China during the early 1930s. His association with what was then called the Department of Buildings and Power began in 1940, and in more than 30 years since then he has been intimately associated with the construction and management of all parts of the Institute's fast-growing physical plant; beginning in 1971, as Associate Director, he was responsible for a major review of all plant-related systems and procedures, with special emphasis on environmental and cost effectiveness.

—**Minor White**, Professor of Photography, is a relative newcomer to M.I.T., but in photography his name has become synonymous with creativity and craftsmanship. The innumerable exhibits and "happenings" he has produced since he joined the faculty to establish the Creative Photography Laboratory in 1965 have displayed many of the basic photography practices outlined in his book, *Zone System Manual*. Before coming to M.I.T., Professor White was a member of the faculty at Rochester Institute of Technology as well as curator of exhibitions and editor of *Image* at George Eastman House in Rochester. His photographs are represented in permanent collections of many museums.

*Douglas P. Adams*
*Professor of Mechanical Engineering*

*A vigorous and persistant stewardship has pervaded all aspects of Doug Adams' 38 years at M.I.T. That span has seen dramatic change in areas he professed in; throughout he asserted himself forcefully and thereby contributed to the evolution of the Institute.*

*The Division of Engineering Graphics he joined when he came to M.I.T. in 1938 merged in 1956 with the Design Division of the Mechanical Engineering Department, where Doug became the mainstay of kinematic analysis. His Harvard mathematical foundation found expression in his novel use of nomography for kinematic synthesis and then, with the advent of the high-speed digital computer, he adapted its power to his professional interest.*

*His sense of service extended well beyond M.I.T.'s walls. A Cantabrigian for most of this period, he assumed responsible roles in Civil Defense, the Boy Scouts, and the Cambridge schools. He expressed his deep interest in history in many ways—his perennial and popular Undergraduate Seminar on the Boston he loves, efforts to restore and publicize Boston's many historical landmarks, and now his and Marian's transplantation to Charlestown to further historical reconstruction there. This interest led to his early appointment (in 1965 by Governor Endicott Peabody) to the Commission for the non-imminent Bicentennial.*

*Professors (particularly aging ones) come to realize that their truly rewarding associations are with their students; the regard they thereby earn is the real, persevering joy. Doug had many such students—those who shared his sense of history, were innoculated with his enthusiasm for kinematics, benefitted from his discipline as departmental baccalaureate thesis coordinator and computer facilities officer, or were endeared to him during his years as advisor to M.I.T.'s chapter of Alpha Phi Omega, the National Service Fraternity.*

*—Robert W. Mann, '50*
*Professor of Engineering*

*Lynwood S. Bryant*
*Professor of History*

*It has been said that Lyn Bryant, whom I have known for 33 years—is retiring. Very well. His accomplishments and commitments are all on record: 40 years here and about of teaching literature, history, and American studies—especially the sociology of American steam engines and the adventure of the American West. Years as Director of the M.I.T. Press; and he did direct it—and developed it, most successfully. Years (with Dolly) as the First Housemaster (and Mistress) of McCormick Hall.*

*But there are those of us who remember the less public occasions. Lyn and Bill Greene mauling a scene from — Aeschylus was it?—in a Greek theatre on a mountain top in Colorado (for an audience of one); Lyn, today, playing a faulty organ and singing faultless hymns and folksongs in his living room with his family and friends; Lyn, more publicly (when WGBH-TV was opposite Building 7), lecturing amiably and knowledgeably—"live"—on the automobile; Lyn quietly planting a tree in New Hampshire in memory of our colleague, Stew Edgerly.*

*So Lyn Bryant is retiring. From M.I.T. only, I would have you understand. Because, like Kilroy, he leaves his signature here and moves on. He won't be "sivilized" though; he can't stand it. He's been there before. Look for him soon on the Ohio River. On a raft.*

*—Theodore Wood, Jr.*
*Professor of Literature*

*Margaret Z. Freeman, S.M.'34*
*Associate Professor of Russian*

*Margaret Freeman's retirement this year marks her 42nd year of continuous service to the M.I.T. community in a wide range of activities—usually several simultaneously—as a classmate and co-worker of members of the scientific community, as an alumna especially interested in women students and alumnae, as a Matron, as a teacher and freshman adviser, and as Director of the Language Laboratory, to give a non-exhaustive list.*

*That she came to M.I.T. is the result of remarkable fortune and perseverance. The outbreak of the Russian Revolution found Margaret Freeman, nee Zaroodny, and her siblings in Siberia, their mother having been tragically killed while their father was in China, with assets consisting of house, garden, and cow, but no cash or fuel. The children (the youngest only two years old) were kept alive and reasonably healthy through two Siberian winters by the ingenuity and devotion of their 20-year-old baby-sitter. The father arranged the family's emigration to Harbin, Manchuria, where Margaret pursued her interest in the arts, gave poetry recitals on the stage, and graduated as an engineer from the Harbin Polytechnic Institute. Somewhere in China there is a bridge that she designed.*

*An American philanthropist with strong ties to Russian culture arranged for the children's emigration to the U.S. in 1932, and presently Margaret came to M.I.T. to study mathematics.*

*These incidents of Margaret's earlier years have made her an invaluable member of the Department of Foreign Literatures and Linguistics. Her experience as an engineer and her practical knowledge of M.I.T. and its students allowed her to become an expert on language laboratory design and applications. Her early training made her valuable as a teacher of language to scientists and engineers, who sometimes feel that humanities are to be taken by default. Margaret has been successful in both worlds: she loved poetry and history, even as she worked in language and technology. Students are fascinated by a person who can speak of the Russian Revolution from first-hand knowledge, and Margaret brings more life and excitement into her teaching than many teachers half her age.*

*—James W. Harris*
*Professor of Spanish and Linguistics*

*Myle J. Holley, Jr. '39*
*Professor of Civil Engineering*

*In the view of his colleagues, "Chris" is always the thoughtful one.*

*His considerations are wide ranging in nature, and in his service to the Institute they have covered such questions as the long-range direction of the education program of the Department of Civil Engineering, even the all-encompassing issue of the survival of the human race. He thought, he analyzed, he presented his cases in well written prose. He carried some of his arguments to the classroom, as in the stimulating subject, "Issues for Survival", which he originated and conducted with the collaboration of Professor William W. Seifert, Sc.D.'51.*

*In his professional practice, Professor Holley is universally recognized for his ability to identify and isolate the fundamental questions that underlie a complex engineering problem. He structures them in a hierarchy of issues, not only for himself to address in his discipline of structural engineering, of which he is a consummate master, but also for the other disciplines involved in the basic problem.*

*He brought this same ability, which he practices professionally, to his classrooms over the many years, thus serving to stimulate and educate many in the same art.*

*—Robert J. Hansen, Sc.D.'48*
*Professor of Civil Engineering*

*William N. Locke*
*Professor of Modern Languages*

*Bill Locke was an academic administrator of the rarest sort, a person who selflessly devoted all of his considerable energy and talents to the creation of an environment where productive scholarship and teaching can flourish.*

*When Bill came to M.I.T. in 1945 to head what was then called the Department of Modern Languages, he found here a small group of people offering mainly elementary instruction in French and German to relatively few students. Bill saw his first task as that of upgrading the Department. He began by strengthening its course offerings. Reading courses designed especially for doctoral candidates were added and enjoyed a huge success in those far-off days when the ability to read scientific materials in two foreign languages was an Institute requirement for the doctorate. He introduced Russian as a regular offering in the Institute catalog. He upgraded the more advanced subjects in the different languages and was responsible for integrating some of these into the undergraduate humanities program. Finally, it was Bill's perception of the unique opportunities that M.I.T. might offer researchers interested in problems of language that led him to build up a research group in this area which in due course evolved into the recognized leader among graduate programs in linguistics the world over.*

*It is characteristic of Bill as a person that when this building program has been completed, when he could see his work whole and know that it was good and solid enough to persist, he resigned as Head of the Department to devote himself to other pursuits, notably the organization and management of M.I.T.'s complex library system. Surveying the Department as it is now one cannot fail to be impressed with the solidity of the structure that Bill first saw in his mind's eye and then succeeded in building. It is an achievement of the first magnitude and a fit tribute to its architect.*

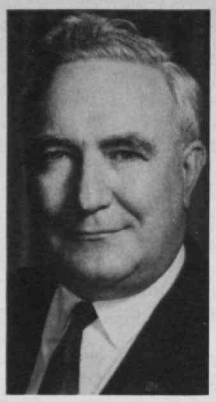
*—Morris Halle*
*Professor of Modern Languages*

*Victor P. Starr, S.M.'38*
*Professor of Meteorology*

*Victor Starr is a true university scholar. His style is always informal and grand; the principles by which he ordered the various aspects of the earth's general atmospheric circulation are universal and should therefore be applied to the universe: planetary atmospheres, spiral galaxies and the circulation of the solar atmosphere have all come under his purview. His lectures are deceptively low key: the principles of conservation of energy, angular momentum and mass as applied to atmospheres and oceans diffuse into one's mind, and one leaves his courses with a realization that meteorology is solidly based as a quantitative science. He convinces students, almost imperceptibly, that the constraints set by the conservation principles produce a beautiful degree of order which is always just under the surface of descriptive meteorology. His enthusiasm for always examining the degree to which the real atmosphere and ocean, as observed, obey the basic principles is highly infectious. Theory is never divorced from reality, and both have to be considered simultaneously for the best overall understanding.*

*In the twenty years I have known Victor Starr I think he has attended only two formal scientific meetings. He wastes little time on the plethora of detail now contained in many modern scientific papers. One feels that his is a very disciplined life, with papers about his results and new ideas continually appearing in the literature, probably composed on the kitchen table at home. During the past 30 years his papers have been more numerous and more instructive, reporting more new results and more new ideas, than those by any other scientist in our field. In a beautiful, flowing prose, these papers have quietly told us how the atmosphere works. Large computer models of the general circulation use atmospheric statistics developed as a result of Victor's efforts. Concerned with the growing human problem of water shortage, Professor Starr has recently worked on the design for a water machine, based on his basic studies of convection and water vapor balance, that could well contribute to ending a water shortage 10 years hence.*

*—Reginald E. Newell, Sc.D.'60*
*Professor of Meteorology*



*George E. Valley, Jr., '35*
*Professor of Physics*

*The hallmark of George Valley's activities at the Institute has been a commitment to the role of education in developing humane qualities as well as intellectual excellence. He was one of the first to be concerned with the total effect of M.I.T.'s program on its undergraduate students. As Undergraduate Planning Professor from 1965 to 1967 he made it his business to learn to see the undergraduate programs from the point of view of the student rather than of the faculty member. In the process he came to recognize the extent to which the traditional structure was an academic and psychological straitjacket for a significant fraction of the students. Building on this knowledge, he pulled together a group of interested faculty and students who developed plans for an unconventional, autonomous organization within M.I.T. that would provide great academic flexibility and a close, informal personal interaction between a group of instructors and their students. Then George Valley became a benign and undogmatic coordinator of this activity—the Experimental Study Group—providing stability and strength and wisdom. In the five years since then the E.S.G. has rewarded his vision by showing itself to be a thriving community of scholars which played a significant role by proving that the high intellectual standards of M.I.T. could be achieved in a multiplicity of styles.*

*—Anthony P. French*
*Professor of Physics*

*George P. Wadsworth, '30*
*Professor of Mathematics*

*George P. Wadsworth has been associated continuously with M.I.T. for 47 years, first as a student and then as a member of the Mathematics Department. He is an excellent teacher and has taught a large number of diverse subjects. In particular, he has been responsible for the statistics offerings from the elementary to the doctorate level.*

*Early in the years of World War II Professor Wadsworth became involved in weather forecasting by statistical methods. At that time the late Norbert Wiener was developing a theory of prediction for purposes of fire control. George Wadsworth's interest in that theory led to its being simplified and adapted to meteorology.*

*Later, through his contact with a Lexington neighbor, Professor Patrick M. Hurley of the Geology Department, George Wadsworth became involved in analyzing seismic data in oil prospecting. By showing how the digital methods adapted from Norbert Wiener's work for meteorology could be used in oil exploration, George Wadsworth began what was a revolutionary innovation in oil prospecting. Hundreds of millions of barrels of oil have been discovered using those methods.*

*—Norman Levinson*
*Institute Professor; Professor of Mathematics*

*Victor F. Weisskopf*
*Professor of Physics*

*Victor Weisskopf has been a major force in modern physics for more than four decades. His scientific researches have been seminal in nature, providing permanent and insightful contributions to our understanding of the physical world. Starting with his Ph.D. thesis on the quantum theory of radiative damping which remains a valid and significant study to this day, he played an important role in developing the modern quantum theory of the interaction of an electron with the electromagnetic field; shift of the 2s level in the hydrogen atom correctly. He was the first to develop a quantum theory of the charged boson field which eventually had its physical realization in the $\pi$ meson. He has contributed to the theory of nuclear reactions and to the modern theoretical foundation of the shell model of the nucleus. His book* Theoretical Nuclear Physics *educated several generations of graduate students and was the primary reference in the field for many years. More recently he has been concerned with the quark model of the nucleons and has been involved in the recent development of the related "bag" model.*

*Professor Weisskopf has also made outstanding contributions as an administrator of science. Under his leadership the European Organization for Nuclear Research (CERN) became one of the leading laboratories in the field of particle physics. Upon his return to M.I.T. from CERN he became the chairman of the High-Energy Physics Advisory Panel of the Atomic Energy Commission, a panel which has been of great importance in determining national policy in the field of particle physics. Finally, but not least, as Head of the M.I.T. Department of Physics for seven years he was remarkably effective in developing a staff which was, simultaneously, outstanding in research and devoted to education.*

*But his most important contribution in my opinion has been his "style," reflected in his physics and in his attitudes toward colleagues and students. Life at M.I.T., particularly in the Physics Department, has been greatly influenced for the better because of his presence and because of his effect on the attitudes of all of us.*

*—Herman Feshbach, Ph.D.'42*
*Professor of Physics*

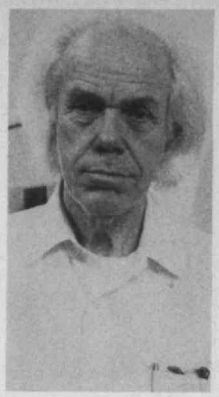
*Donald Whiston, '32*
*Deputy Director of the Physical Plant*

*Donald Whiston has always represented the best tradition of service to the M.I.T. community. Throughout his career this has taken the form of being available and eager to serve at any time of day or night in any season, of always trying to find ways to say "yes" to service requests while at the same time protecting the long-term interests of the Institute. His loyalty and devotion are universally recognized and appreciated by all elements of M.I.T.*

*Professionally, Don is a well trained and experienced engineer, skilled in construction, maintenance, and service operations. In recent years he has assumed principal responsibility for M.I.T.'s physical plant environmental concerns and become a recognized expert in waste disposal. His work with student groups interested in these matters produced innovative and effective results about the Institute.*

*But most of all, he will be remembered by his colleagues for his coolness and indomitable spirit in the variety of crises which operating a large physical plant such as ours inevitably entails. Whether in fire, flood, hurricane, major equipment failure, or time of unrest, he was a resourceful and energetic leader.*

*—Philip A. Stoddard, '40*
*Vice President, Operations*



*Minor White*
*Professor of Photography*

*Photography is a place where technology and art come together, not on a collision course but in marriage. So it is with Minor White: If you want to discusss the "H & D" curves or the "zones," you will find Minor a learned teacher; if you want to discuss the sensitive, elusive art that may exist in the "would of silver" you will find Minor an inspiring teacher.*

*His merry humor, his kind but objective criticism, his blend of objectivity and subjectivity make him great. Perhaps this blend is symbolized by his running a lottery to choose who are the lucky students from the many who apply who will be fortunate to learn from him.*

*Many, many people who have not had the excitement of being in his courses have nevertheless been students of Minor White through studying his beautiful, sensitive, radiant photographs and reading his beautiful prose.*

*M.I.T. has been honored to have one of the world's great photographers on its faculty. And those of us who have had the privilege and fun of knowing Minor White know that he has felt honored in being here.*

*—Gregory Smith, '30*
*Undergraduate Research Opportunities Program*

## Advanced Study in International Nutrition

A new attack on malnutrition in developing countries will be mounted at M.I.T. next fall with the start of a special advanced study program in international nutrition planning. A year-long program, primarily for officials of governments and international agencies who are or may become involved in planning, implementing, or evaluating work to combat malnutrition in low-income countries, will include coursework, seminars, and in some cases field work.

Program coordinator is John O. Field, Research Associate in the Center for International Studies, who is a member of the International Nutrition Planning Program, established in 1972 by the Center and the Department of Nutrition and Food Science.

## Character Recognition Reader

An optical character recognition machine has been given to the Research Laboratory of Electronics by its manufacturer, ECRM, Inc., of Bedford, Mass., for use in research on cognitive information processing.

The "Autoreader" machine is typically used to "read" typewritten material, producing automatically a punched paper tape for controlling type-setting machines. It can also "read" a typed computer program in order to convert it into computer code, and it can "read" typewritten copy for use in other computer-controlled devices. All three applications were demonstrated at a ceremony this spring at which the machine was formally presented to R.L.E.—the last of the three purposes being related to a computer now being developed at R.L.E. to produce synthetic speech.

Principals in the ceremony this spring included Bruce Cooperman and Amram Rasiel, President and Chairman of the Board, respectively, of ECRM, Inc.; President Jerome B. Wiesner; Professor Albert G. Hill, Vice President for Research; Professor Henry J. Zimmermann, Director of R.L.E.; and Professor Donald E. Troxel, Ph.D.'62, whose R.L.E. project will be a principal user of the ECRM machine.

## 64 to Phi Beta Kappa

Sixty-four members of the Class of 1974 have been honored by election to Phi Beta Kappa, the highest honor for academic achievement in the humanities, social sciences, and sciences which is available at M.I.T.

Nine of these honored are women; 18 are majors in mathematics, 17 in life sciences, nine in physics, seven in chemistry.

Their honor is unique: M.I.T. is the only institute of technology which has been granted a Phi Beta Kappa chapter, and its members are the only students in Phi Beta Kappa who receive S.B., not B.A., degrees. Cumulative grade averages of 4.8 and higher are normally necessary for election at the Institute.

## The Corporation Elects Four and Re-Elects Five

Four new members have joined the M.I.T. Corporation, and five members whose terms expired on July 1 have been re-elected.

The four new members are:

—Gregory C. Chisholm, '73, who was nominated by members of the Classes of 1972, 1973, and 1974 in a national balloting in the spring, was elected as Representative from Recent Classes for a five-year term.

—Thomas F. Creamer, '40, Executive Vice President of the First National City Bank of New York, was chosen for a five-year Term Membership on the Corporation.

—Edward E. David, Jr., Sc.D.'50, Executive Vice President and Director of Gould Industries, Term Member for five years.

—Charles E. Reed, Sc.D.'37, Senior Vice President of General Electric Co., Term Member for five years.

The five re-elected members, all of whom were named to additional five-year terms having first been chosen for such terms in 1969, are:

—James A. Champy, '63, lawyer, of Lawrence, Mass.

—Jerome H. Holland, former Ambassador to Sweden

—Breene M. Kerr, '51, Senior Partner in the Resource Analysis and Management Group and in Howell-Kerr Enterprises, both of Oklahoma City, Okla.

—Carl M. Mueller, '41, Managing Partner of Loeb, Rhoades and Co.

—Jeptha H. Wade, '46, Partner in Choate, Hall and Stewart, Boston

Mr. Chisholm, who completed work for his S.M. degree in mechanical engineering this June, was active in student affairs throughout his undergraduate career at the Institute; he was Chairman of the Black Students Union, coordinator of freshman orientation, Commodore of the M.I.T. Rowing Club, Co-Captain of the Varsity Heavyweight Crew, and a member of the Corporation Joint Advisory Committee, and he was awarded a Karl Taylor Compton Prize in 1973. He was the successful candidate among seven whose names appeared on the annual ballot for nomination as a Representative from Recent Classes.

Mr. Creamer continued at M.I.T. as Assistant to the President for two years after graduating in management, then served for an additional four years as Executive Assistant to Karl T. Compton when the latter was Head of the Office of Field Service with the Office of Scientific Research and Development. Mr. Creamer joined the First National City Bank in 1946.

Before taking his present position, Dr. David was for two years Special Science Adviser to President Richard M. Nixon; he came to that assignment from the post of Executive Director—Research at Bell Telephone Laboratories. Inc.; his M.I.T. degrees are in the field of communications in the Department of Electrical Engineering.

Dr. Reed joined the M.I.T. Department of Chemical Engineering upon completing graduate studies in that field; his under-

*G. Chisholm*

*T. F. Creamer*

*E. E. David, Jr.*

*C. E. Reed*

*J. A. Champy*

*J. H. Holland*

*B. M. Kerr*

*C. M. Mueller*

*J. H. Wade*

graduate degree is from Case Institute of Technology. He has held various management positions with General Electric Co. since joining that firm in 1942.

## A Compton Prize for Mrs. Compton; and Other Awards

To her astonishment, the tables were turned on Mrs. Karl Taylor Compton at the 1974 Awards Convocation. Just after she gave coveted prizes—named in honor of the late Dr. Compton, M.I.T.'s ninth President—to three M.I.T. undergraduates, Paul E. Gray, '54, Chancellor, called her back to the rostrum for her own Compton Prize.

"For the last 20 years that Mrs. Compton has been present at these award ceremonies," said Dr. Gray, "she has spoken freshly and persuasively for tolerance, brotherhood, and the rights of each person to be different." The citation for Mrs. Compton's award: "trusted interpreter of citizenship and community."

Deeply moved, Mrs. Compton responded: "It is with mounting gratitude that I think of my coming to M.I.T. . . . At no other campus that I have ever been on have I felt such a thrusting into the future, a dealing with reality. . . . I congratulate and thank all of you."

Mrs. Compton had presented the 1974 Compton Prizes to:

—**Samuel E. Denard,** '74, for "common sense effectiveness in developing contacts between black students at M.I.T. and the industrial world in which many M.I.T. graduates make their careers. . . and for his work in the Black Students Union."

—**Janet D. Stoltz,** '74, for "substantial contributions. . . through her work in supporting Hillel, through service with Alpha Phi Omega, and in many other ways."

—**Sandra G. Yulke**, '74, for "unique and important contributions to communications between women faculty, students, and staff at M.I.T. . . . and through journalism and athletics."

Other major awards given at the annual convocation:

—The Scott Paper Foundation Leadership Award for "demonstrated high character . . . and potential for outstanding contributions to . . . engineering" to **Patricia R. Callahan,** '75, who will use her $2,000 prize money for a fourth and fifth year of study in mechanical engineering.

—The Everett Moore Baker Award for outstanding undergraduate teaching to **William G. Thilly**, Sc.D.'71, Assistant Professor of Toxicology in the Department of Nutrition and Food Science.

—Goodwin Medals for "conspicuously effective teaching by graduate students" to **Ihab H. Farag**, Chem.E.'71, of the Department of Chemical Engineering and **Ronald M. Hollander** of the Department of Metallurgy and Materials Science.

—The James N. Murphy Award for "spirited contributions to the Institute family which have won a place in the hearts of students" to **John H. Murphy** (no relation), equipment manager for the M.I.T. Athletic Department.

*1974 was the 20th presentation of the Karl Taylor Compton Prizes for "outstanding contributions in promoting high standards of performance and citizenship within the Institute community." After she gave three of them to eminent undergraduates (left to right, Samuel E. Denard, Jr., '74, Sandra G. Yulke, '74, and Janet D. Stoltz, '74), Mrs. Compton was recalled to the stage of the Awards Convocation to receive a Compton Prize of her own as "trusted interpreter of citizenship and community."*

## The First Coed Fraternity Presidents in the U.S.: "It's Just Like a House With a Large Family"

Two M.I.T. coeds are stretching the dictionary definition of "fraternity" completely out of shape.

Carol McGuire, '75, invaded two predominantly male preserves three years ago—the world of engineering and the M.I.T. chapter of Sigma Nu, the national social fraternity. Now she's been elected President of the Sigma Nu house; and so far as she knows that makes her the first woman social fraternity president anywhere.

And Elizabeth F. Wise, '74, is completing her year as President of the M.I.T. chapter of Alpha Phi Omega, the national service fraternity. A record here, too: Miss Wise is engaged to a former President of A.P.O., and she guesses that they may be "the first two past presidents of a chapter of a Greek letter fraternity to marry each other."

Sigma Nu was one of two M.I.T. fraternities that first pledged coeds three years ago—the other was Delta Psi (the M.I.T. chapter is known as the Number Six Club).

Carol joined Sigma Nu "because I liked the people and it's a good place to live," she said. "I didn't like dormitory living, with the empty halls and locked doors and that sort of thing." Some 35 fraternity members—about a third of them women—apparently share those sentiments as residents of the Sigma Nu house, located on St. Paul St. in Brookline.

"I ran for president because I want to help make it a good place to live after I'm gone," says Carol.

She admits the introduction of women to Sigma Nu and her election as president (the official designation is "commander"), have not been without problems. "Some people did leave the house originally when it was decided to go coed," she said, "but there didn't seem to be any bitterness. They more or less said that if the house wanted to go coed, that was fine, but that they couldn't live in that situation."

What about coed living in a three-floor Victorian house which has general rooms on the first floor, study rooms in the basement and second floor, and a dormitory on the top floor? No problems, says Carol. Men and women have separate bathrooms and shower rooms, and the living arrangements aren't different from those in any home housing a large family.

"The only hassles," she says, "are when all the girls are trying to take showers at the same time. But I had those at home with my sisters."

But Carol's boyfriend at Harvard does, on occasion, make a joke at her expense.

"He likes to tell people he is meeting for the first time that he's dating a mechanical engineer from M.I.T. who is a fraternity president just to see what kind of a reaction he gets."

The fact that the national offices of the two fraternities haven't officially recognized the women members or permitted them to be initiated (the fraternity constitutions prohibit women members) is not a serious problem. Both local chapters have simply made their presidents equal participants in all the activities and are unconcerned about the national implications.

*M. Donahue*

## "You've Got Guts!"—The Air Force's First Coed Cadet Corps Commander

"You've got guts, Martha," her friends tell her when she shows up in class wearing an Air Force R.O.T.C. uniform. They're right: Martha J. Donahue, '75, is the first coed in the history of R.O.T.C. at M.I.T. to be named Cadet Corps Commander.

Miss Donahue, whose father is Joseph M. Donahue, '44, has been headed for leadership in R.O.T.C. ever since she joined the Air Force program as a freshman. She was promoted to staff sergeant as a sophomore and soon thereafter became Commander of the Arnold Air Society.

But Miss Donahue's interest in R.O.T.C. has little to do with "intentionally breaking down male/female stereotypes," she insists. The point is simply that Miss Donahue is a major in the Sloan School of Management, she thinks she has inherited her "ability to make up her mind" from her father who studied in the Sloan School before her, and she wants to be assigned as a Second Lieutenant to work in research and development management at Patrick Air Force Base, Florida, when she completes her M.I.T. degree twelve months hence.

## C.A.E.S.: Keeping Up to Date at M.I.T.—and in Japan

He had a bachelor's degree in mechanical engineering and 15 years of professional experience behind him, responsible for many successful engineering projects: as a test engineer, a product engineer, and an engineering manager. Although he had an excellent background in engineering, after spending several years in a relatively nontechnical capacity, his return to engineering as manager of a mechanical engineering team highlighted the fact that he had begun to fall behind in the latest advancements in his field, plus the advances in technology around him—particularly the improved methods of analyzing problems as systems instead of components.

So he decided to enter the Advanced Study Program of the M.I.T. Center for Advanced Engineering Study, and for a full academic year he spent most of his time learning the methods and tools for scientific business management. With help from the Center, he worked out a program which included subjects and discussions in the management of science and technology, management systems, policy analysis, computer systems, research management, probability theory, random processes, and operations research.

It's a typical case history of a C.A.E.S. Fellow, says Paul E. Brown, Assistant Director of the Center, and it serves to make specific the purpose of one of its major activities. More than 40 engineers and scientists with several years of professional experience and records of professional accomplishment will join the Program in the fall of 1974, says Dr. Brown, and applications from others who want to enter in February, 1975, will be due late in the fall of 1974.

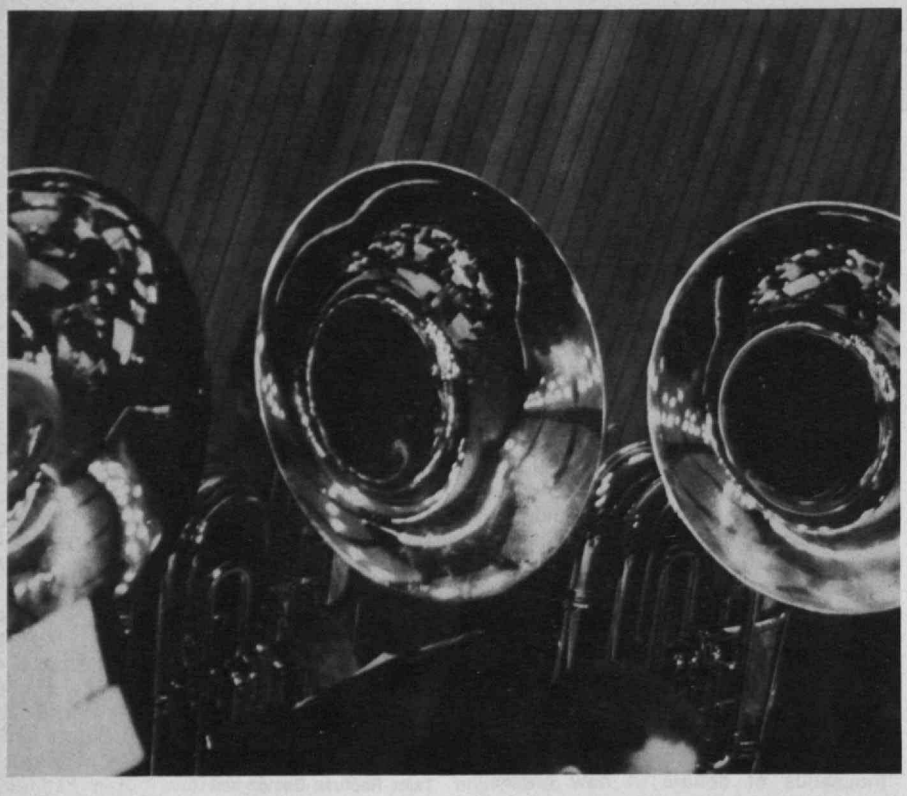
Meanwhile, recognition has come to another C.A.E.S. activity—self-study courses consisting of packaged videotaped lectures and study guides in mathematics, chemistry, and engineering subjects.

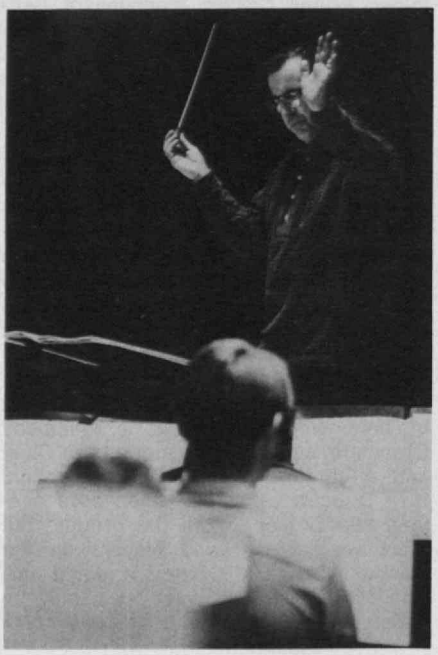
In addition to distribution in the United States by C.A.E.S., the self-study courses are now being distributed in Japan by the National Translation Institute of Science and Technology, and N.A.T.I.S.T. expects that engineers and scientists from 200 leading Japanese corporations will be using them this year. It will represent "thousands of dollars in new orders," thinks Arthur Collias, Manager of Self-Study Subject Distribution at C.A.E.S.

## The Concert Band at 25: A Dali Instead of a Rembrandt

Even after 25 of them as Conductor of the M.I.T. Concert Band, John D. Corley finds "each musical season exciting." It's because, every year, "we bring to the ears of the audience a new work." This year it was St. Clair's *Double Concerto for Two Pianos,* composed in 1972. Like everything the Band has played since 1953, the Double Concerto was written for band, not orchestra.

The story of the Concert Band begins in 1948, when M.I.T. had a Symphony Orchestra, an R.O.T.C. band, a Glee Club, and a chorale group; Klaus Liepmann, then Director of Music, acted as a one-man coordinator for all the groups. But there were more wind players on the campus than the Orchestra could use (the R.O.T.C. band was open only to cadets), and to solve this problem some





*If "band" brings to you images of popcorn, Cokes, and cheerleaders, think again: the M.I.T. Concert Band, now 25 years old, has sought for more than 20 years to change that image by serious playing of serious music as a "concert instrument." Never a dull moment in that whole quarter-century, says John D. Corley (right), who has conducted the Band ever since its beginning; every season there's a new work and new audiences. (Photos: Daniel L. De Hainaut, '74, from Technique)*

75 musicians led by James L. Burkhardt, '51, a student in the Symphony, organized their own group and asked Mr. Corley, then Director of Music at the Brookline Public Schools, to direct. Mr. Corley recalls Professor Liepmann's advice in 1948: keep them so busy that "music becomes both work and relaxation."

**A Band as a "Serious Instrument"**

At first the group was hesitant to call themselves a *band* because they were serious musicians and " 'band' connotes popcorn, Coca Cola, out-of-doors music," Mr. Corley recalls. So in their first programs the Concert Band mixed light and serious works, daring to alternate familiar with unfamiliar, original band music. The unfamiliar works caught on, and on May 8, 1949, the Band gave its first concert containing only works written for band. The concept of "a band as a serious concert instrument" had emerged. Much of the impetus for this idea came—and still comes—from the students. Mr. Corley stresses that its members want the Band to be an idiom of its own; why should they imitate an orchestra when music can be given new expression, perhaps even a new definition?

As affairs proceeded, the Band discovered that there was a limited repertoire of music written for band before the 20th century. So most of its concerts consisted of contemporary works; from there it was a short step to commissioning works specifically for the M.I.T. Concert Band. Among these new works were several by a Band member, Andrew F. Kazdin, S.M.'63, now Producer of Columbia Masterworks. His *March Baroque,* first performed at M.I.T., has been played by the Philadelphia Orchestra, and many of his pieces are familiar favorites in Cambridge.

Because the music is contemporary, it tends to be complex. Indeed, only a handful of other colleges were performing original works for band in the 1950s, and even today the number remains small. But members of the M.I.T. Concert Band would not have their music otherwise; they consider widely published band music so dull that they don't want to be bothered with it. In an ordinary band the good performers carry the load because only a few are assigned difficult parts. But with original music every instrument and every chair are indispensable, so there is pressure and challenge for everyone—and, equally, a sense of accomplishment for even the last chair player.

Most of today's Band members are undergraduates majoring in fields other than music. The Band began with one woman, now boasts seven; in the 1960s, Barbara R. Padgett, '69, was the first woman to be its President.

**How to Understand Modern Music**

The group rehearses three hours a week, performs a fall concert at M.I.T., several concerts on a winter tour ranging from Canada to Florida, a post-tour concert at M.I.T., an ensemble concert, and a spring concert. The purpose of all this is to learn and enjoy the music and to expose audiences—especially M.I.T. students—to this particular, unusual musical

form. Though at least one member of the Band—Mr. Kazdin—has gone on to a career in music, the purpose is not to train professional musicians.

In 1972, for example, the Band performed *Werk*, an electronic piece which was endured by senior citizens and received a mixed reaction from students. A reporter for the Orlando, Florida *Sentinel* commented on a 1970 concert which featured another contemporary work: "It was like expecting a portrait of Rembrandt and finding a Dali in its place." A new member of the Band remarked to Mr. Corley this year, "You know, contemporary music is easier for me to understand in the band idiom than orchestra."

John Corley is a professional trumpeter who has played with the Boston Symphony and the Metropolitan Opera, conducted the Boston Pops and the El Paso Symphony. He's recently given up his duties in the Brookline schools, but he continues as the Band's enthusiastic conductor. "One of the things that distinguish the M.I.T. Band," he says, "is the alertness of the men and women and their ability to retain detail. I love their enthusiasm for playing, for trying new pieces, and yet their reverence for the old masters."—*Barbara J. Saltzstein*

## Christenings: the Wiesner, the Johnson, the Burns, and the Jope

Two unique experiences have come to Howard W. Johnson, Chairman of the Corporation, and President Jerome B. Wiesner on the dock of the Pierce Boathouse this spring: their names are now on eight-oared shells used by M.I.T. crews.

For President Wiesner it was a "singular honor," he said—the first time anything had ever been named for him, and he hardly knew how to act. Then he offered a bit of philosophy in which he saw a "national lesson": "There's nothing wrong with winning, but it does matter how you win."

And Howard Johnson found himself "more moved than I thought I would be." He recalled that the first new building dedicated under his Presidency of M.I.T. was the Pierce Boathouse, and now while he reads the *New York Times* before breakfast every morning in his penthouse overlooking the Charles River Basin he will know that some of the oars he hears from the river will be those on the *Howard W. Johnson*.

The *Johnson* is M.I.T.'s first fiberglass shell; it will lead the men's lightweight fleet.

Two other dedications at the Pierce Boathouse this spring, too:

—A four-oared racing shell named for David S. Burns, '72. He's been the coach of M.I.T.'s first coed varsity crew, and the christening of the *Burns* is on the occasion of his leaving Cambridge to continue graduate work at Stanford University.

—A coaching launch bearing the name of the late Ralph T. Jope, '26, which will be assigned to the coed varsity crew. Mr. Jope, for many years Business Manager of *Technology Review*, was an ardent fan of rowing at M.I.T.


*A tradition as old as crew at M.I.T. was reenacted four times at the Pierce boathouse this spring, to the evident pride and pleasure of the principals. New shells were christened in honor of President Jerome B. Wiesner, Chairman Howard W. Johnson, and David S. Burns, '72, who coached M.I.T.'s first coed varsity crew to major intercollegiate victories; and a new coaching launch was named in honor of the late Ralph T. Jope, '26. The pictures show (above) the traditional tribute to Mr. and Mrs. Johnson and—behind them—Mrs. Jope and her then-fiance, Walter J. Smith, Secretary of the Class of 1928; and (left) some of Mr. Burns' charges preparing to make the inaugural cruise of the "Dave Burns 72." (Photos: Margo Foote and Jet)*

*Even before these pictures were taken, Joe Garagiola of NBC News was excited about M.I.T.'s "refreshing" sports program. "Once upon a time," he recalled in a broadcast a year ago, "colleges had sports programs because they figured the kids would enjoy them. They were meant to be fun. That theory died out pretty much," said Mr. Garagiola, "but not completely—not at M.I.T. . . . (where they've not) lost sight of what sports should really be like." Here are some data for those who want captions for pictures:*

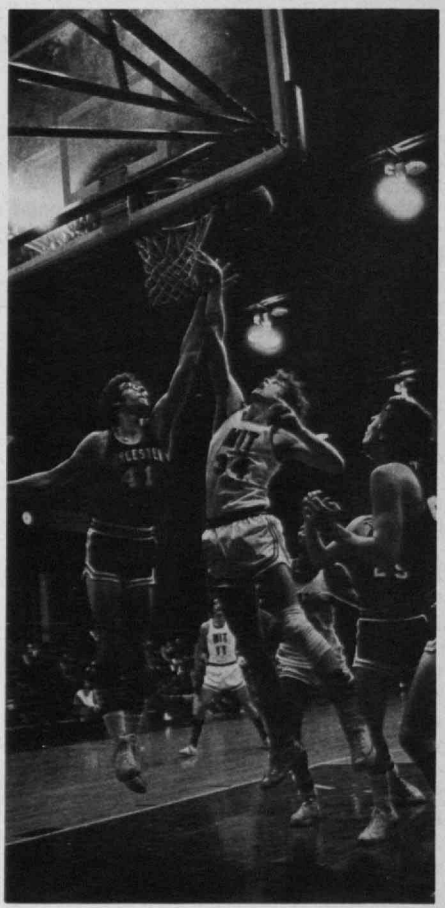
*—The pole vaulter is Stephen Hyland, '76, at the Eastern I.C.A.A. championships; it's not recorded whether he cleared the bar this time, but M.I.T. placed 13th in the 20-team meet.*

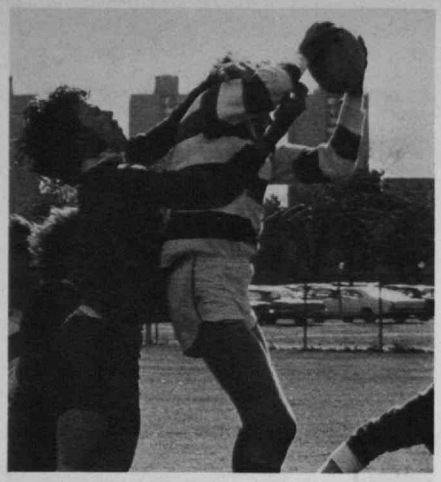
*—The rowers are M.I.T.'s varsity women's eight, photographed as they beat Williams and Phillips Academy; at the end of their first season in varsity status, the coeds took fifth among 15 schools in the New England Association of Women's Rowing Colleges sprints.*

*—The water polo photo was made as the season opened last fall with an invitational tournament. The rest of the season was better forgotten—12 starts, one win.*

*—The basketball picture shows center G. William Courtright 2nd, '76, battling W.P.I. for a rebound and M.I.T. scored an upset, 81-72.*

*—The best M.I.T. could do at the Eastern I.C.A.A. outdoor track meet was fourth in the 440-yd. relay; the picture shows James S. Banks, '76, starting his leg.*





## New Sports Rules and a Host of Champions; What Happens When We Join the "Academic" Crowd?

Rejoicing abounds in the Athletic Department whenever the conversation turns to events of the 1973-74 varsity season. Two reasons:

—M.I.T. varsity teams set enough new records to make the season a clear success. The baseball team was invited to its first-ever post-season tournament by the N.C.A.A.; Johan Akerman, '77, and his colleagues brought the Intercollegiate Fencing Association championship to M.I.T. for the first time in history; and the heavyweight crew placed second—behind only Wisconsin—in the national Intercollegiate Rowing Association regatta at Syracuse early in June.

—The National Collegiate Athletic Association during the year adopted a new plan for decentralized rules which Ross H. Smith, Director of Athletics, thinks will give many schools—including M.I.T.—a better chance to follow their own philosophies of varsity athletic competition.

**"A Compatibility Arrangement"**

The new N.C.A.A. rules put M.I.T. teams in a division and district that is sometimes dubbed an "academic crowd." And if all the members of that division can agree, some long-standing N.C.A.A. rules can be changed for this group of competitors.

The eligibility rules, for example. Today's rule, to discourage athletic transfers, says that a student who transfers to a new school cannot compete for that school in varsity competition in his first year there. But people transfer to M.I.T. for academic reasons, not for athletics, and Professor Smith hopes to have transfer students eligible for varsity sports immediately.

Another change M.I.T. will propose: let a student who finishes his undergraduate degree in three years, and then continues on for graduate work at the same school, complete his four years of varsity N.C.A.A. eligibility. As it stands, graduate students are not eligible for varsity play, and every year this rule eliminates a few M.I.T. students who want their full four years' experience.

The N.C.A.A. limits the athletic scholarships a school can award. But the rule has little meaning at M.I.T., and Professor Smith will propose that all schools in M.I.T.'s division renounce athletic scholarships, using "need" as the sole basis for scholarship support.

*Fencing was the high point of the athletic season, and Johan G. Akerman, '77, the high point of the fencing season. He's shown (left) with the "Little Iron Man" trophy, the national championship of the Intercollegiate Fencing Association which he and two colleagues brought to M.I.T. for the first time in history. It's "the most prestigious fencing team title in the country," the oldest intercollegiate athletic trophy in the U.S. (Photos pp. 96-97: Russell K. Johnsen, '76, from The Tech; David H. Green, '75, from The Tech; Daniel L. De Hainaut, '74, from Technique; Fred H. Hutchison, '75, from The Tech; Robert A. Olshaker, '76, from The Tech; and Edward J. MacCabe, '75, from Technique)*

**The "Little Iron Man" to M.I.T.**

Some highlights of the varsity winter sports:

—After making a 12-1 record in regular competition, M.I.T.'s "superb varsity fencing squad" (*The Tech*'s words) was the favorite for the New England championship. Right on; the Engineers topped a field of 11, "looked unbeatable from the start," and "rolled up a remarkable total of 54 wins." Kong Park, '75, won first in the sabre competition, Johan Akerman, '77, second in the foil weapon. A week later Mr. Akerman teamed with two more freshmen, Richard Reimer and Arlie Sterling, to take the coveted foil team title at the 77th annual Intercollegiate Fencing Association Championships at Harvard; the next day Mr. Akerman won the tournament's individual championship. The team victory brought the "Little Iron Man" trophy, oldest of all intercollegiate athletic trophies in the U.S., to M.I.T.

—The basketball team had a 4-19 record which *The Tech* said was "the worst mark in the school's history." But some of the hurt was removed when, in the last game of the season, the team finally "meshed their individual talents perfectly" (Glenn Brownstein, '77, in *The Tech*) to defeat W.P.I. 81-72.

—M.I.T. gymnasts claimed fourth place in the New England Championships, a "good performance" and "a satisfying end to the season," said Paul J. Bayer, '73.

—The rifle team was third in the Greater Boston Rifle League with a 7-3 record.

—The M.I.T. baseball team spent a long, anguishing weekend in May. They were good—a 15-7 season, with a team batting average of over .290. The first invitation to a post-season tournament ever to come to M.I.T. arrived on May 15—the Eastern College Athletic Council's regional baseball tournament. But the team wanted bigger stakes, turned down the E.C.A.C. and gambled on an invitation—it came soon enough—from the National Collegiate Athletic Association district playoff. But that's where the good news stopped: New Haven won the first game of the tournament at Princeton, N.J., 6-1.

—M.I.T.'s pistol team capped off its best season ever with a national team championship, the third time in the past four years that M.I.T. has won outright or shared the National Collegiate Pistol crown.

—After two days of the hardest kind of work in Amherst, Mass., the M.I.T. rugby team brought home the New England championship. In a space of 28 hours the "ruggers" won four games, two of them in double overtimes, and even *The Tech* was convinced: "surely the best that New England has to offer."

—The table tennis team captured the Ivy League-M.I.T. championship after a season in which the "A" team was undefeated and the "B" team lost only to Harvard and Cornell.

## "Invaluable Contributions" to Chemical Engineering

For 34 years Margaret S. Barrett served the Department of Chemical Engineering in its headquarters, and "three successive department heads learned to rely on her knowledge, judgment, and loyalty to the Department and to the Institute."

That's ended now, with Mrs. Barrett's retirement early in 1974; but the quotation—from remarks by Raymond F. Baddour, Sc.D.'51, Head of the Department, at a retirement party, is how she will be remembered by faculty and alumni alike.

Mrs. Barrett first came to M.I.T. in 1935 to work with Earl B. Millard, Professor of Chemistry, who was writing a book on physical chemistry. She moved to the Department of Chemical Engineering in 1940, after a short assignment with the late Nathaniel McL. Sage ('13) in the Division of Industrial Cooperation; and since then she has served Walter G. Whitman, '17, Warren K. Lewis, '05, the late Edwin R. Gilliland ('33), and Professor Baddour during their assignments as Heads and Acting Heads of the Department—a long career with many memories.

## Individuals Noteworthy

**David Atlas**, Sc.D.'51, of the National Center for Atmospheric Research, was recently a member of a delegation of meteorologists who undertook a two-week visit to the People's Republic of China. The trip, sponsored by the American Meteorological Society and its counterpart organization in the People's Republic of China, was designed to advance the international exchange of information in the atmospheric sciences. . . . Professor of Literature at M.I.T., **Albert R. Gurney, Jr.**, has written a play that the *London Times* has acclaimed as "the best mainstream play to come out of America since the debut of Arthur Miller." "Children," a two-act satire, opened at London's Mermaid Theatre on April 8, and is expected to be produced in a regional U.S. company.

Twenty members of the M.I.T. community have been honored by election to the National Academy of Engineering; it is "the highest professional distinction that can be conferred on an American engineer," says the Academy, intended to honor "those who have made important contributions to engineering theory and practice or who have demonstrated unusual accomplishments in the pioneering of new and developing fields of technology." The 20 are: **Howard C. Barnes** (Prog. for Senior Exec. '60), Deputy Chief Engineer, American Electric Power Service Corp.; **Jordan J. Baruch**, '47, Lecturer in Business Administration, Harvard University; **Richard H. Battin**, '45, Assistant Director, Charles S. Draper Laboratory, Inc.; **William B. Bergen**, '37, President, North American Aerospace Group, Rockwell International; **Roy W. Carlson**, Sc.D. '39, Consultant, Berkeley, Calif.; **Harold Chestnut**, '39, Consultant, General Electric Co.; **Mildred S. Dresselhaus**, Professor of Electrical Engineering; **James L. Everett**, III, S.M. '59, President, Philadelphia Electric Co.; **Daniel J. Fink**, '49, Vice President, General Electric Co.; **Joseph G. Gavin, Jr.**, '41, Chairman and Chief Executive Officer, Grumman Aerospace Corp.; **Vladimir Haensel**, S.M. '37, President, Universal Oil Products Co.; **Donald R. F. Harleman**, Sc.D. '50, Professor of Civil Engineering; **Hoyt C. Hottel**, '24, Emeritus Professor of Chemical Engineering; **John Lowe, III**, S.M. '37, Partner, Tippetts-Abbett-McCarthy-Stratton; **Fujio Matsuda**, Sc.D. '52, Professor of Civil Engineering, University of Hawaii; **Robert Plunkett**, '39, Professor of Mechanical Engineering, University of Minnesota; **Ronald F. Scott**, Sc.D. '55, Professor of Civil Engineering, California Institute of Technology; **Ascher H. Shapiro**, '38, Professor of Mechanical Engineering; **C. Richard Soderberg**, '20, Dean of Engineering Emeritus; **Walter G. Whitman**, '17, Emeritus Professor of Chemical Engineering (Professor Whitman's election was announced just five days before his death in Scottsdale, Ariz.); and **Thornton A. Wilson**, S.M. '53, Chairman and Chief Executive Officer, Boeing Co.

Seven members of the M.I.T. community been chosen for membership in the National Academy of Sciences in recognition for "distinguished and continuing achievements in original research": **David Baltimore**, Professor of Microbiology; **Solomon J. Buchsbaum**, Ph.D. '57, Executive Director—Research, Communications Principles Division, Bell Telephone Laboratories, Inc.; Dr. **Jerome Gross**, '39, Professor of Medicine, Har-

*After 10 years of effort, the compatible time-shared system (C.T.S.S.) for managing a single computer in simultaneous service for many users was phased out at M.I.T. in July, 1973. It was a major effort of Project MAC ("multiple access computer"); its direct applications have been substantial, and its influence has been pervasive. Hence a special honor on March 20 to Fernando J. Corbato, Ph.D.'56, Professor of Electrical Engineering, to recognize his leadership of the C.T.S.S. work: a desk set fabricated from an element of the C.T.S.S. disc-file storage system. Presenting the award, President Jerome B. Wiesner credited the project with "a tremendous revolution in computation" through its emphasis on "great accessibility"; Professor Corbato and his associates made "important contributions to computation and the Institute," Dr. Wiesner said. Richard G. Mills, '54, Vice President of the First National City Bank of New York (he was associated with computer projects at M.I.T. from 1963 to 1970), agreed: "You've taught a whole generation of people to be demanding," he told Professor Corbato.*

*Responding, Professor Corbato found it all "a very sentimental affair." That there are "alumni" of the C.T.S.S. work in so many places throughout the U.S.—many of them couldn't come to the ceremony—is "a very seminal thing," he thinks; the project "led a lot of people to start thinking about what could be, and now they've gone out to try to do it." (Photo: Sheldon Lowenthal)*

vard Medical School; **Ali Javan**, Professor of Physics; Dr. **Hamish N. Munro**, Professor of Physiological Chemistry; **Irwin I. Shapiro**, Professor of Geophysics and of Physics; and **John S. Waugh**, Professor of Chemistry.

### Corporate Appointments

**Maurice P. Andrien**, '63, has been appointed group head of Kaman's music companies. . . . **Shepard M. Arkin**, '46, has been named to the position of Director, Program Development for Raytheon Company's Missile Systems Division. . . . **Harold T. Bright**, S.M.'68, has been appointed Vice President of Blackstone Corporation. . . . **Howard S. Bryant**, Sc.D.'52, has been named Corporate Vice President, Engineering at Witco Chemical Corporation. . . . **Donald B. Cameron**, '41, has been appointed a Vice President of the Battery Products Division of Union Carbide Corporation. . . . **Thomas J. Cerny**, '64, has been appointed Vice President, Finance for the communications and information services group of Arcata National Corporation. . . . **Bernard Chertow**, Sc.D.'48, has been named General Manager of Syracuse Bulk Operations for the Industrial Division of Bristol-Myers Company. . . . Hershey Foods Corporation has named **William Christensen**, '39, Manager of Project Engineering and Construction. . . . **Roozbeh Chubak**, '69, has been named Advertising Media Manager for Merck Sharp and Dohme, a division of Merck and Company, Inc. . . . Infrared Industries, Inc. has elected **Gilbert Davidson**, '55, a Vice President. . . . Spaulding and Slye Corporation has appointed **Richard E. Dobroth**, '50, as Executive Vice President, Residential Development. . . . **Howard H. Fawcett, Jr.**, '52, has a new business affiliation as Manager of Facility Planning at Offshore Power Systems Corporation. . . . St. Regis Paper Company's Sherman Division has been consolidated into its Laminated and Coated Products Division and **Kermit Greene**, '47, has been named Divisional General Manager of the consolidated operation. . . . **George K. Landon, Jr.**, '45, has been named Vice President and General Manager of the Plastic Container Division of Continental Can Company. . . . **Paul L. McGill**, '51, has been appointed central regional sales Vice President at Combustion Engineering, Inc. . . . **Lee R. Morris**, S.M.'54, has assumed responsibility for I.N.A. Corporation's Corporate Development and Planning Department. . . . **Lawrence Partridge**, MAR'60, is coordinator of the new Birmingham regional office of The Ritchie Organization. . . . **Thomas Popek**, S.M. '67, has been appointed Manager of International Business Planning and Control in the International Division of Fairchild Camera and Instrument Corp. . . . **Frederick J. Port**, '40, has been elected to The Penn Mutual Life Insurance Company's Board of Trustees. . . . **Vernon S. C. Porter**, '57, has been appointed Superintendent, Rolling and Finishing Mills-South at C.F. and I. Steel's Pueblo Plant. . . . **Robert L. Richards, Jr.**, Sc.D.'51, has been appointed Assistant General Manager of the Du Pont Company's Film Department. . . . **Arthur E. Schiller, Jr.**, S.M.'67, has been named General Marketing Manager for Bell of Pennsylvania's central area at Harrisburg. . . . **Philip L. Smith**, '65, has been appointed Financial Director at Brand-Rex Company. . . . Cleveland Metal Abrasive, Inc., has named **C. B. Sung**, S.M.'48, President and Chief Executive Officer. . . . **W. Blair Thompson**, S.M.'60, has been named General Manager of Delco Products. . . . **Carroll G. Tompson**, S.M.'69, has been elected Vice President, Director of Manufacturing and a member of the Board of Directors of R. J. Reynolds Tobacco Company.

**Harold M. Brodsky**, '47, has been named Vice President of Operations, and **Robert M. Toppin**, '39, Vice President of Manufacturing at The Fafnir Bearing Company, division of Textron. . . . Loctite Corporation has named **Richard J. Dauksys**, S.M.'70, Manager of New Product Planning, and **Gary E. Frashier**, S.M.'70, Vice President of Manufacturing, Americas Group. . . . **Edward Dinowitz**, '49, has been named Manager of Engineering, and **Andre P. Sampou**, '54, Vice President for Manufacturing at Instron Corporation. . . . **Howard E. Simmons, Jr.**, '51, has been named Director of Research for the Du Pont Company's Central Research Department, and **William D. Phillips**, Ph.D.'51, has been transferred to the Development Department to head technical programs in connection with a food protein venture.

### University Appointments

**Ronald P. Black,** Ph.D. '64, has been appointed senior research scientist in the international programs of the University of Denver Research Institute. . . .**Edward H. Bowman,** '46, has been appointed Dean of Ohio State University's College of Administrative Science. . . .**Sterling G. Brisbin,** '50, has been appointed Adjunct Associate Professor at Cornell University. . . .Lowell Technological Institute has named **Ian A. Forbes,** Ph.D.'70, Chairman of the Nuclear Engineering Department. . . .**Janet B. Guernsey,** Ph.D.'55, has been appointed Chairman of the Department of Physics at Michigan State University. . . .**L. Philip Howland,** Ph.D.'57, has been promoted to full professor from associate professor at Whitman College. . . .**H. W. Mergler,** '45, has been appointed to the Leonard Case Jr. Chair in Engineering at Case Institute of Technology. . . .Menlo College has named **G. William Rollosson,** S.M. '47, Dean of Engineering and Sciences . . . .Emory University School of Medicine has named **James W. Sweeney,** Ph.D.'54, clinical professor. . . .**Peter T. Van Aken**, '63, has been named Assistant to the President and Director of Analytical Services at Brandeis U.

## David J. Tobin, 1920-1974

David J. Tobin, who was associated with M.I.T. as Institute Secretary for Charitable Trusts and Special Assistant to the Vice President and Secretary from 1964 to 1973, died in Hinsdale, Ill., on May 8.

At the time of his death, Mr. Tobin was a member of the staff of the Institute of Gas Technology in Chicago.

## Deceased

Charles J. Griffin, '03, March 20, 1974
Errett M. Graham, '05, April 26, 1974*
Chester R. Shaw, '05, September, 1973
Charles E. Smart, '05, December 27, 1973
Professor Henry W. Blackburn, '08, September 19, 1973
Frank E. Mott, '08, March 16, 1974
Mrs. John H. Williams, '08, April 16, 1974
George A. Morrison, '09, May 2, 1974
Walter S. Davis, '10, September, 1973
Richard R. Taylor, '10, April 2, 1974
John A. Urquhart, '11, October 1, 1973
Miss Hattie D. F. Haub, '12, March 20, 1974
Guy A. Swenson, '12, December 2, 1973
Clarence W. Brett, '13, January 1, 1974
Richard B. Cross, '13, February 21, 1974
Charles H. Burns, '14, April 17, 1974*
Charles T. Blackmore, '15, March 27, 1974
Theodore G. Brown, '15, April 17, 1974
Charles B. Malone, Jr., '15, April 21, 1974
Joseph L. Brodil, '16, March 2, 1974
George P. Igleheart, '17, May 14, 1974
I. Edmund Waechter, '17, November 14, 1973
David A. Reed, Jr., '20, August 25, 1973
A. Cameron Hayden, '21, April 1, 1973
Winthrop E. Luke, '21, April 3, 1974
Edwin T. Steffian, '21, April 26, 1974
Captain William C. Wade, '21, March, 1974
Earold C. Jewett, '22, April 18, 1974
Arthur L. Pitman, '22, April 26, 1974
Kenneth R. Sutherland, '22, April 17, 1974
Miss Anna A. Mohring, '23, February 12, 1974
Captain Floyd A. Tusler, 23, March 13, 1974*
George H. Arapakis, '24, October, 1972*
John L. Del Cardayre, '24, April 3, 1974*
Colonel Burton F. Lewis, '24, March 27, 1974*
Victor J. Moyes, '24, March 20, 1974*
Curtis W. Chapin, '25, February 12, 1973
Miss Ruth E. Densford, '25, May 14, 1973
Laurent C. Roy, '25, February 13, 1974
Professor Anthony D. Hoadley, '26, April 30, 1974
Roland H. Maser, '26, March 19, 1974
Captain Dale Quarton, '26, April 7, 1974
James B. Castner, '27, December, 1973
James M. W. Chamberlain, '27, April 17, 1974*
Charles H. Tedford, '27, February 27, 1974*
Aram J. Vart, '27, March 27, 1974*
Rear Admiral David S. Crawford, '28, April 29, 1973
David Mathoff, '28, April 11, 1974
George M. Armstrong, '29, April 12, 1974
Kenneth W. Grimley, '29, April 9, 1974
Dr. Charles N. Henshaw, '29, March 21, 1974
Paul S. Kingsley, '29, May 16, 1974
John H. Powell, '29, December 25, 1973
Garret E. Green, '30, September 19, 1973
Philip B. Howe, '30, May 18, 1973
Godfrey E. Thomson '30, February 10, 1974*
Daniel B. Knight, '31, April 25, 1974
William H. Barker, '32, April 28, 1974
Francis E. Elmer, '32, July 28, 1972
Thomas R. Hartigan, '32, January 20, 1974
William R. Schuler, '32, May 4, 1974
Walter J. Farrell, '33, December, 1973
Joseph H. Wetherell, '33, October 9, 1973
J. Sterling White, '34, May 10, 1974
John E. Talbert, '35, December 15, 1973
Jean L. Leman, '36, February 10, 1974*
Dr. Milo M. Bolstad, '38, April 14, 1974
Daniel P. Lacock, '38, October 29, 1973
James E. Watkins, '40, March 22, 1974
Lars H. Nordenson, '41, July 26, 1972
Myron D. Phillips, '41, December 3, 1972
Captain John M. Waters, '44, April 24, 1974
Clifford H. Black, '46, May 14, 1972
Calvin M. Newman, '46, May 13, 1973
Charles M. Wiswell, '48, April 30, 1974
Miss Mary R. Norton, '49, March 27, 1974
Edward F. Martin, '50, March 26, 1974
Glenn A. Eichenseer, '51, April 15, 1974
Lawrence J. Reed, '52, March 13, 1974
Emil C. Hervol, '56, March 25, 1974
Ambrose J. Petzinger, '57, December, 1973
Mrs. Sandra L. Goodwin, '58, January 23, 1973
Professor David R. Waldbaum, '60, April 13, 1974
Robert E. Oaklund, '64, March 9, 1974
Harry Schrage, '65, August 3, 1973
John M. Gonsiewski, '69, February 23, 1974
Dr. Richard D. Gillespie, '70, June, 1972
*Further information in *Class Review*

# Class Review

## 98

On our way north with the trailer, we stopped in Hendersonville, N.C., to see Mrs. Olive Buckley, the daughter of the late **George K. Newbury** (see June Class Notes). She was out golfing! His granddaughter and great-grandson were charming.

It was a pleasure to hear in April from the Honorary Member **Dr. George R. Harrison**. He wrote, "Although I don't feel particularly ill, I have had four operations in the Mass. General Hospital in the past 12 months, and we have not been able to do much travelling. We did manage to get to Finland, Estonia, Leningrad and Moscow last June between operations, but that has been our only trip covering any distance during the past year. I am winding up my work at M.I.T. so as to close my office next month. The large grating ruling engine I developed over the past 25 years is now operating to full satisfaction, and it has been presented by M.I.T. to the National Science Foundation, one of the engine's principal supporters. It is being set up for operation at Kitt Peak National Observatory in Tucson, Ariz. We plan to stay fairly close to Concord during the summer and I expect to get in to the Institute at least once a week, even though my formal connections are now very tenuous."

The passing of **Alvan L. Davis** saddens us. Edward H. Davis, also from Waterbury, Conn., wrote that his brother died on February 4, 1974. Alan took Course III at M.I.T., mining engineering, and graduated in '98 with a B.S. degree. He would have been 99 on May 11. The following is taken fron a report of '98 printed 30 years after graduation: Born in Hyde Park, Mass.; attended Chauncy Hall School in Boston; lived in Waterbury, Conn., where he was Research Engineer with the Scovill Manufacturing Co.; Treasurer of the Bennett Metal Treating Co., Elmwood, Conn. Professional Societies: A.I.M.E., American Society for Steel Treating, National Economic League, Sound Money League, Member of the British Institute of Metals and the American Society of Mechanical Engineers, American Association for the Advancement of Science. Civic Organizations: Rational Press Association of London, England. Social Societies: Overlook, Cottage Park Association, Waterbury, Conn. Hobbies: chess, bridge, gardening, mountain climbing. He married Helen Ludlum in 1902 and had a son in 1904. Our sympathy goes to his brother, Edward, who will send me more information concerning Alvan's life. There may be other survivors.—**Mrs. Audrey Jones Jones**, P.O. Box 294, Forest Park Station, Springfield, Mass. 01108

## 03

Well classmates, I would be pleased to receive even a post card from you. It would assist me in keeping our news column open.

However there are several birthdays to boast of: **Clarence M. Joyce** on April 1, 1881, Montclaire, N.J.; and **Benjamin D. Solomon** on July 2, 1881, Auburndale, Mass.—**John J. A. Nolan**, Secretary-Treasurer, 13 Linden Ave., Somerville, Mass. 02143

## 05

A letter from Ernest W. Graham tells of the death of his father **Errett Graham** on April 26, 1974. He was the oldest member of the Class; would have been 97 in June. The Friday *Harbor Journal* of May 2 included these words about Errett. He was a resident of Shaw Island for over 30 years, died in the Islands Convalescent Center. He was born in Kentland, Indiana on June 8, 1877. He graduated from Butler University and M.I.T. In 1904 he married Helena Washburn of Rensselaer, Indiana. His career in civil engineering for the railroads took the young couple to some remote construction camps and small towns in Tennessee and West Virginia.

Mr. Graham traveled around the world in 1912-13, going first to Japan and then crossing Russia by the Trans-Siberian railroad. His many other adventures included an early hot-air balloon trip and parachute drop.

Following his retirement, the Grahams spent a year in Seattle and then settled on Shaw Island in 1941. There he took up a second career as a land surveyor, which he continued for over 25 years. He was San Juan county engineer for 12 of those years.

His favorite mode of transportation between the islands, both for business and pleasure, was by canoe, and his slight figure steadily paddling the forest-green Old Town Guide Model became a familiar sight in the San Juans. He celebrated his 91st birthday circumnavigating Lopez Island by canoe—solo.

Mr. Graham was preceded in death by his wife in 1970, just two days before their 66th wedding anniversary. He is survived by three children: Ernest W. Graham of Shaw Island, Mrs. Lorin G. Hibbard of Berkeley, Calif. and Mrs. Louis P. Smithmeyer of Seattle.

Thus passeth a grand old rugged character, whom none of us has seen since graduation. I enjoy looking at his picture taken three years ago, while he was paddling his canoe around Puget Sound.

On Alumni Day we will miss one (yes two) regulars, **Leonard Cronkite**. Mrs. Cronkite writes that he is in a nursing home with "atrophy of the brain." He is in Pine Knoll Nursing Home in Lexington, Mass., and would undoubtedly be able to appreciate letters from his classmates. I hope for better news in the next issue.—**Fred W. Goldthwait**, Secretary, Box 231, Center Sandwich, N.H. 03227

## 07

One industrious classmate has written a letter to the Editor of the *Star* in Winchester, Mass. It is **Walter B. Kirby**, Noble Horizons, Apt. D-1, Salisbury, Conn. 06068. With a title "How is Winchester Village Today?", Mr. Kirby's letter begins, "Editor of the *Star*: Having lived in Winchester from about 1888 to 1904, when Prince Wilson published *The Winchester Star*, I would be interested to receive a copy of your newspaper just to see how your paper has developed and how the village of your Winchester is today.

"I was a member of the class of 1903 Winchester High School, and am now 89 years old.

"May I add that I am an architect, M.I.T., '07-'08, and practiced in New York City from 1912 to 1950, and in New Canaan, Conn., from 1903 to 1952.

"I won the M.I.T. architectural traveling fellowship and also attended the American Academy in Rome, Italy.

"As an avocation, I am a painter of landscapes, having done more than 400 throughout the U.S.A."

Although **Willis Waldo** will soon have passed his ninety-first birthday, he is still

*The 1974 Alumni Day in Rockwell Cage brought these "old timers" together: Eugene H. Russell, Jr., '04 (seated clockwise); Mrs. Goldthwait (standing); Fred W. Goldthwait, '05; Lloyd T. Buell, '05; Joseph W. Wattles, 3rd, '08; John J. Nolan, '03; Stanley G. H. Fitch, '00 and Henry Buff, '05.*

active in his work in civil and structural engineering. Waldo is the only living member of the group who has maintained continuous membership in the 200-member Engineers' Association of Nashville Tennessee. He joined this organization on December 16, 1916 and was one of the organizers. . . . **Phil P. Greenwood** included a word on his Alumni Fund envelope, "In quite good health but am subject to some of the ailments of old age. Drive my car locally in daylight. Try to maintain my present physical condition by daily push-ups and walks of a mile or two each day weather permitting. Main hobbies: genealogy and reading but have to use a magnifying glass for most of my reading. Some TV and radio for news and special programs."

Our final bit of news is from **George A. Griffin**, who adds, "I enjoy reading the news of the Class of 1907 and keeping up to date with M.I.T."—M.K.

# 08

We have two more deaths to report for 1973 according to the Alumni office—Professor **Henry W. Blackburn**, M.E., 973 Lancaster Ave., Syracuse, N.Y. 13210.

Professor Blackburn died September 19, 1973. He taught mechanical engineering at the University of Syracuse.

Another death to report for 1973 according to a newspaper clipping sent in by Wilfred E. Booth Class Agent—Mr. **C. Frederick Joy** (87), 50 Meredith Cr., Milton, Mass. Ex-town official, former Superintendent of the Milton Sewer Department where he served for 40 years, Mr. Joy died at the Milton Hospital after a long illness. He was a graduate of M.I.T. in civil engineering. He became well-known throughout the state as a sanitary engineer. He had also engaged in private surveying in and about Milton.

He was active in the Masons as a Knight Templar, was a member of the Shriners and a charter member of the Milton Lodge A.F. and A.M. where he received his 50-year pin a few years ago. He was also a member of the Vestry of Saint Michael's Church.

Surviving is his widow, Miriam (Martin) Joy, three stepsons; Henry Whitcomb of Chicago, Robert Whitcomb of Milwaukee, and Ann Steel of Cambridge, and a sister Ethel M. Joy of Chelsea.

A more recent death is that of **Mrs. John H. Williams**, 6300 Green St., Philadelphia, Pa., (Formerly Miss Gertrude Marvin, '08). Mrs. Williams died April 16, 1974.

Change of address this month: **Roger C. Rice**, C.E., 527 Adams Ave., Los Banos, Ga. 93635.

A word from **Henry R. Sewell**: "Sorry unable to attend the 65th Reunion on account of temporary illness. Am now completely retired, but remain a South Scituate Bank Cooperator in Norwell."—**Joseph W. Wattles**, Secretary, 26 Bullard Rd., Weston, Mass. 02913

# 11

I have just received word from the Alumni Association of the death of **Ralph S. Pease**, 127 Main St., Medway, Mass., on March 28. He had been for some time in the Essex Rest Home in Essex, Co.

A new address: **Stanley H. Lawton**, C/O Southern Worsted Mills, 10 High St., Boston, Mass.

To meet a deadline, this is being written the last week in May and before Alumni Days. I have not missed an Alumni Day for many years, but arthritis has me crippled to a point where I do not feel able to go this year. The only other classmates, **O. W. Stewart** and **Morris Omansky**, who have attended regularly in recent years will not be there either. O. W. does not feel up to it physically and Morris died last March. Here are some excerpts from Morris' obituary in the *Boston Globe* for March 31: "Mr. Omansky appeared as an expert witness in many industrial espionage cases in the rubber, plastics, leather and textile industries and held many patents in chemical products.

"Mr. Omansky received his B.S. degree from M.I.T. in 1911 and served as an industrial consultant to the U.S. Army and Navy during both world wars.

"He was a member of the American Chemical Society, a Fellow of the American Association for the Advancement of Science, a member of the American Institute of Chemical Engineers and M.I.T.'s Stein Club. Mr. Omansky also served as a consultant to the Jewish Vocational Services of Boston."—**Oberlin S. Clark**, Secretary, 50 Leonard Rd., North Weymouth, Mass. 02191

# 12

I plan to attend the 1974 Alumni Day events on June 2 and 3, but so far **Albion Davis** and I are the only 1912 men registered. I expect, however, to meet three or four of our regular attendants at the luncheon. It has lately become more and more difficult to get news contributions.

**Johathan Noyes** writes that his general health continues to be good and that he is on the go most of the time. Five of his children live in Texas and he "makes the circuit" frequently to San Antonio, Edinburg, Corpus Christi, Houston, Bryan, and to Dallas occasionally. He greatly enjoyed his trip in March to Mexico City and Oaxaca, attending the M.I.T. Mexican Fiesta with some 60 "gringos" present of which he was the oldest. Johnnie plans to leave in June for his usual summer in Brooklin, Maine, making a number of visits en route from North Carolina to Massachusetts. I am hoping that he will stop here for a visit. . . . Very belatedly, from his son-in-law, we have learned that **Milton Kahn**, who has had an established business in paper box boards in Boston for many years, has been quite ill for the past ten years. This accounts for our failure to hear from him. We have extended to him the sympathy of the Class.

I am reporting two address changes. **Wally Murray** has moved from Sebago Lake to 66A South St., Gorham, Maine 04038. **Charlie Willis**, who lived in Lexington for many years, has moved to 1033 Mass. Avenue, Arlington, Mass. 02174.—**Ray E. Wilson**, Secretary, 304 Park Ave., Swarthmore, Pa. 19081

# 13

The 1974 Alumni Days with the many attractive programs and special events will be another historical chapter when you read these notes. It is a pleasure to us to receive a letter from **Allen Brewer** announcing the publishing of his latest publication, *Effective Lubrication* by the Robert E. Krieger Publishing Co., Inc., P.O. Box 542, Huntington, N.Y., and we quote Allen's last letter: "Well, *Effective Lubrication* became an actuality about a month ago. It's a relief to have attained an objective which we aspired to when I began work on this text over two years

*Ray Dinsmore, '14, (third from the left) addressed these words to his classmates and guests at their 60th reunion dinner on June 1, 1974:*

*We have returned—we of the'60's tribe—*
*To gaze once more into the face of this a changed and changing Alma Mater.*
*Nimbly has she stepped across the Charles—*
*Spread wide—and then thrust upward,*
*While we watched both classic and self-innovated styles invoke her structures.*
*Her foster children meanwhile, came and went.*
*Their aspect changed—at times—to the destruction of the shelters they had sought.*
*Abundantly, the fount of Knowledge ever slaked the veritable thirst*
*Though learned fools, in pompous ignorance of life*
*Tricked some to sweep the board and trust the dice.*
*No fear! This too shall pass.*
*The Universal Truth, though burned with fire,*
*Still, from the dross, shall yield the gold—though we be dead.*
*For Her Great Name is founded on a base, so firm*
*None can destroy—none ever smirch its fame.*

ago. It's quite an imposing book, and we hope it will be well received by the managerial, lubrication and maintenance people in industry. Keep your fingers crossed for us. Now to bring you up-to-date as far as the 'Tute goes. Last summer I wrote to Dick Knight at the Alumni Association to inquire as to how my publisher could contact the Institute when the book was available. I was informed that Professor Brandon G. Rightmire of the mechanical engineering department has a course related to lubrication. Mr. Knight also asked me to arrange for a review copy of this book to be sent to John Mattill, Editor of *Technology Review.*

"As for family news. We both got through the rigors(?) of the Florida winter quite well. Maurine did contract a case of thrombo-phlebitis in her right leg a few months ago which cramped her style temporarily. It responded well to medical treatment and cooperation by the patient in keeping off her feet as much as possible, with right leg elevated on a foot stool when sitting. Now that is well under control. But more recently she got a cold which settled in her chest, requiring inhalation therapy and antibiotic medication. That, too, has been well controlled, so presently she is about 'rarin to go' out in the yard to catch up for lost time. We hope you folks can tell us good news as to the Maine winter. Sometimes the weather reports down here do not look too promising when the northern states are discussed. But with the coming of spring and the tulips, etc., budding, we hope you are doing fine. We are not planning on any northern or western travels this summer, as of now. We'll just 'play it by ear', and if the gas condition gets more encouraging we might get the urge later on."

**Heinie Glidden** has contacted Dick Knight regarding a possible interesting exhibit of M.I.T. Alumni, who paint either as a hobby, or who have turned professional in the Arts (watercolor or oil). We quote from Heinie's letter to Dick Knight and Dick's reply: "Phil Capen has nudged me again to write you more details regarding the idea of exhibitions of art work by Alumni, to be held at reunion times. Am enclosing a copy of the announcement of such an exhibition held in 1962. This is the sort of thing I had in mind, except to make it more inclusive and therefore more interesting to more people. Of course the work of alumni, widely recognized as artists, should be shown, but also such things as are suitable, done as a hobby, diversion or just for pure enjoyment. It is probably too late to get a showing ready for this coming Alumni Day, but a meeting for interested alumni might be arranged, possibly with a few paintings, drawings, and sculptures, to present the idea and lay the groundwork for future Alumni Day showings. We are planning to be in Cambridge for the Alumni Day luncheon, so perhaps you and I can find a few minutes to discuss this idea at that time."

From Dick Knight to Mr. Glidden we quote: "Many thanks for your thoughtful letter regarding the possibility of an exhibition of art by M.I.T. alumni/alumnae. As you pointed out, these things require considerable time and planning effort. I have sent copies of the 1962 program and your letter to a few members of the faculty who have an interest in the arts and I am anxious to get their comments and suggestions."

We quote from Heinie's note to us: "Enclosed is a copy of letter to Dick Knight which I finally managed to write, also the cover of the 1962 announcement of an exhibition of alumni art works. Have been very much involved in housework, as well as painting. Although watercolor is my usual medium, the latest one is an oil which was entered in the Duxbury Art Association. It was accepted and is now hanging in the Duxbury Art Complex. Jane and I are planning to be at the luncheon on Alumni Day. Haven't heard anything further re the Alumni Advisory Council, and as things are now, don't see how I could get to those monthly meetings."

**Walter Muther**, writes: "I'm working hard on the garden and just finished ploughing today. Here's to a bountiful crop. The daffodils are in full bloom, also some tulips. I'm thankful to be able to get around. Had a severe attack of spinal arthritis just before Christmas. My legs don't hold me up as well as they should. With my sauna bath and a daily nap, perhaps I'll make it. Hope to see you at the 65th." Good luck, Walter, and we'll be looking forward to seeing you and your charming daughter, Sally Lawton, on Alumni Day. . . . It was very gratifying to receive a phone call today from **Bill Brewster**, advising us of his and Ellen's yearly visit to Florida, and that all is well. So take your pen in hand and let us know what your present and future plans may be. Until the October/November issue of the *Review,* this is it.—**George P. Capen**, Secretary and Treasurer; **Rosalind R. Capen**, Assistant Secretary, Granite Point Rd., Biddeford, Maine 04005

# 14

When these notes were written late in May, 12 members of the Class and five wives had signed up for our 60th Reunion, to be held at the Institute on Saturday afternoon and evening, June 1, and the next morning; and to be followed by Alumni Days Sunday afternoon and Monday.

**Charles H. Burns** died on April 17 in a hospital near his home in Shafter, Calif., at the age of 82. He was a graduate of Franklin and Marshall College, was with us in our last two undergraduate years,

and received his M.I.T. degree in Course X. He served in the A.E.F. as a lieutenant in World War I. His early career was with Raybestos Manhattan, Inc., and he lived in Lancaster, Pa., his native city, and in other eastern states until 1938. He then moved to Shafter, where he engaged in poultry farming until his retirement. He is survived by his wife, Athol, two daughters and two sisters.—**Charles H. Chatfield**, Secretary, 177 Steele Rd., West Hartford, Conn. 06119

# 15

Our new Class Agent, **Joyce Brado** in Lockport, N.Y., taking over for **Ben Neal**, is doing an admirable job. Many classmates have written her fine personal letters of thanks for her interest, loyalty and devotion to do this for Ben and for our Class. All have referred to past, pleasant friendships with Ben. Joyce's knowledge of the job and of Ben's methods are invaluable. Nice going, Joyce and many thanks from the rest of us. One annual class cocktail party and dinner at the M.I.T. Faculty Club here on Alumni Day June 3 was our usual outstanding success, enjoyed by 29 for cocktails and 16 for dinner following—a good show. The "younger members" of the Class with their families were particularly welcome. We want them to come every year. It was great to have Ethel Rooney with us and the widows the boys are beginning to bring with them. Barbara Thomas, really a part of the Class, with her friendly and personable presence added a great deal as a gracious hostess. Long distance plaudits to **Larry Baily** and **Ray Delano**, Duxbury; **Wayne Bradley**, Moosup, Conn.; **Jack Dalton** and **Pop Wood**, Peterboro, N.H., **John Daeton**, Providence; **Archie Morrison**, Swampscott; **Fred** and **Mrs. Waters**, Marblehead; **Larry Quirk**, Middletown, Conn., **Max Mythaler** and Mrs. Knight, Framingham; **Horatio Lanison** brought his daughter, Shirley; and the attractive Jeanette and **Bill Sheils** added a lot. Jack Mohr, '50 and Jean Mohr (Wellesley 1949) and their two daughters Bonnie and Heidi were with us. More exciting class news from the dues letters.

**C. Ellis Ellicott, Jr.**, writes, "I feel guilty in not writing but we live a quiet life and don't really generate much news. Since our Scandinavian cruise early last summer, we have been very much stay-at-homes with the exception of our regular Christmas excursion to Boston, where we have three sets of children in Concord, Lexington and Beverly Farms. All these families are appropriately equipped with grandchildren.

"We don't have any travel plans at the moment, but hope to spend three weeks at Martha's Vineyard in August." . . . We have word from **Deoch Fulton** who says, "I'm alone now but downeast Maine is friendly country, with pleasant living. Last spring I visited my daughter and her family in California and called on our classmate **John Gallagher** and his wife Erma in Los Angeles. They are happily surrounded by grandchildren. In a few months I'll be drifting out of the dubious seventies and will come to anchor in the cool and quiet eighties. Should be restful."

**Ray Gladding** says, "I have finally retired, in good health. Change my address to 8190 Wheeler Ave., Fontana, Calif. 92335.

**Loring Hall** writes, "You certainly are not extravagant about dues. There is not much to report, except the arrival of a third great-grandson. The oldest one plays chess with me by mail and beats me.

"I still maintain an office where I go several times a week, but I confess my labors are not strenuous. Ruth and I take four 'vacations' a year—all at different places. We have just returned from St. Croix, Virgin Islands, where we enjoy the golf and the swimming. In spite of the continuing racial friction there, we haven't been shot at yet.

"Our favorite spot is Boothbay Harbor, Maine, where we spend July and part of August. In my opinion Maine is the least 'spoiled' of the 50 states. We like Arizona in March and Biloxi, Miss., in November.

"When we are home we keep busy in the garden or on the golf course. I still serve as a volunteer in a V.A. hospital at Allen Park where I share my stamp-collecting hobby with those veterans who have a similar interest.

"There are no other fifteeners around here so I look forward to reading the Class Notes. You have done much to keep the class spirit going."

We have word that **Francis Hann** is "alive and active, not as fast as 1911, on the freshman relay team, but retired after practicing law in New York City and Los Angeles for many years. Personal best wishes to you and others." . . . **John Homan** wrote in reference to our 60th Reunion, "Azel, 1975 is a *long* way off: However I expect to be there providing I don't have to drive a car. Azel, how do you expect to take all those trips if the checks are sent to M.I.T.?" . . . **Otto Hilbert** tells us that he feels fine and keeps as busy as he wants to, going through company records to record information of historical interest. All of which he enjoys very much.

**Joseph M. Livermore** recalls hoping to attend our 60th Reunion at our 55th but some surgery last August and September has slowed him down. He says that he is steadily recovering but travelling has been out of order. His son in Oregon comes East every few months and his daughter in Cambridge frequently visits. Joe adds, "Our grandson, Tom Reid, will have his doctorate in advanced biology from Leland Stanford this summer. He has organized a group to prepare 'Environmental Impact Analysis' and has his office in Palo Alto. His wife will also have her doctorate at the same time.

"Keep up your courage, Azel. We've had a long and interesting life. You have done a marvellous service to the classmates for 60 years, one we'll never forget." . . . **Forrest Legard** has semi-retired. "I am at 83 years and not working very hard. I have one daughter in Los Angeles; one daughter is a school nurse in Melrose, Mass; one daughter in Camden, Maine and one here in Bath. One son-in-law is a Los Angeles insurance adjuster, and one a Metrose salesman, Salada Tea Co. Still active in Masonic bodies." . . . Mrs. **Charles B. Malone** writes from Umatilla, Fla., "I have had you on my list to write and was disturbed that there were no '15 Class Notes in the last issue. Hope you and Fran are better." . . . **Bob Mitchell** writes, "Nineteen fifteen to 1974 is a long way isn't it? Those were the good old days! And I am happy to be able to say that I find the present days good too. My children have all done well and their children (seven) are now finishing college at Cornell. One grandson, genius-type, I wanted to go to M.I.T. but his choice was Cornell. His father is Department Head in Civil Engineering. All are top-notch skiers in competition, and all are good sailors from my training. One granddaughter crewed last year on an ocean race—Antigua to Gibraltar. I've had to quit sailing—joints getting too stiff for fast action in a breeze. But I go to Cape Cod every summer where we have a cottage, and fish and sail a bit with the 'kids'. Here in Florida my big thing is gardening."

**Herman E. Morse** writes, "Having passed 80 last November, my present target is to try and be well enough to get to the 1975 Reunion, our 60th. If I make it I will set another target. So far Marjorie and I have been pretty well, she suffers in silence with a lot of arthritis but in other respects is reasonably well. We hope to leave here in late February for a few months in Florida at our place in Ormond Beach.

"Our greatest interest is our great-granddaughter, three and a half. Three granddaughters are through college, two married, one in a bank in Columbus. The one grandson is in second-year law school at Emory in Atlanta. He is a graduate chemical engineer from Purdue."

Bee and **Charlie Norton** left their favorite Martha's Vineyard for two weeks at Mt. Desert Island, Maine in April. . . . **Stanley Osborn** writes that he was in the hospital for a three-week stay in the fall and again in January and "became a changed classmate despite the phlebitis that put me under, although I was not pregnant at either time.

"Five squirrels keep me busy here. The 84 ducks that are out back come up for breakfast each morning and awake me with their quacks at 6:43 a.m. Am glad the robins have come for they chase the blackbirds which dominate the bird kingdom here. The ten white swans keep them away also. Only eight grandchildren so far, six girls and two boys." . . . **Frank Parsons** is doing fine, loves the Florida sunshine and six grandchildren. He was expecting to visit his sister in California in March and so should make the 60th next year.

**Larry Quirk** writes, "I was very sorry to learn of George's death. I have written to Mrs. Rooney and Gerry. George was the last of our old Chandler St. gang. We cannot do much touring with the gas shortage but the weather stays dry and sunny. See you in June." . . . **Mary Rice** writes that she has six great-grandchildren. She adds, "I'm looking forward to our 60th with much pleasure. Surely it will be held at McCormick Hall. Mrs.

McCormick (née Katherine Dexter) had the same ancestor as I—Thomas Dexter, who landed in Ipswich in 1629. I always stay there and will miss her friendly greeting.

"I was so sure I was going—after six weeks in London—from London to Kyoto next August with a group also wanting to go by way of Peking and Shanghai. I've waited for the promised form to fill out but nothing yet. If that trip is impossible, maybe I can take one of the trips from London to Russia before returning home. New York is too hot in 100-degree heat. Sorry to miss the 59th. Have fun."

And finally our last classmate to write is **Fred Stetson.** "Retired to Florida 15 years ago and wouldn't want to live anywhere else. We have a daughter and three grandchildren living in Winchester whom we see occasionally. I play a little bridge with **Everett Brigham** once a week at bridge club. Otherwise do a few chores and enjoy myself."

**Charles T. Blackmore** died March 24, 1974 at Yarmouth, Mass. . . . **Sidney E. Clarke** died August 17, 1973 in Westport, Conn. Many will remember the delightful music he wrote for Tech shows during our old Tech days.

You'll all be glad to know **Louie Young** has recovered from his hip fracture that laid him up painfully for a long time. I recently visited him at home and he is feeling and doing fine. . . . **Bill Brackett** has had a tough time in the New England Baptist Hospital here, with severe and serious surgery. His left hip joint was replaced by a steel ball and a plastic socket—a remarkable job. I visited him at the hospital and found him in good spirits.

**Theodore G. Brown** died April 17 in Manchester, Conn.

I hope you all and your families enjoy a healthy and happy summer.

That's all for this month.—**Azel Mack,** Apt. 26A, 100 Memorial Dr., Cambridge, Mass. 02142

# 16

Now that the 58th Reunion is past all you have to do is to wait until the 59th next June. No doubt all things went as our ever-forward-looking President **Ralph Fletcher** predicted they would in his March letter to all of us: "I am happy to announce with great enthusiasm the call for attendance at our 58th, June 4, 5, and 6. The scenic and refreshing beauty of the Cape shoreline beckons. The comfort, excellent service and the menu of the Chatham Bars Inn awaits us. The genuine interest and affection of our classmates will be there for all to share and enjoy. Each one of us is rather special now, and just a handshake and a brief conversation become quite precious." A full account of just what happened and who did what at the Cape will appear in the first issue of the *Review* this fall. . . . We must acknowledge the kindness of the Class of 1915 and especially its friendly long-term faithful Secretary, Azel Mack, in inviting us to attend their annual cocktail party and dinner at the M.I.T. Faculty Club on Alumni Day in June. Very sorry we were unable to be there!

As for the group picture of last year's reunion, we have this bit of encouragement or wisdom from our most distinguished classmate of all, our noted **Van Bush,** received just after his birthday in March: "I'm proud to belong to such a good-looking group. This '16 bunch doesn't look any older as the years go by, especially the women!" . . . You may remember that in the February issue, **Art Shuey** wrote that one of the most interesting people he and Mildred met and ate with several times on the *Canberra* eclipse trip last June was Dr. Mildred Allen, a physicist and the daughter of "Pops Allen", who used to teach railroad engineering back in Tech. To help show how small the world really is, a letter from Lois and **Charlie Lawrance** notes that Mildred Allen is a close and dear Vassar College classmate of Lois's—a friend ever since 1912 when, says Lois, "accompanied by our mothers we became Vassar freshmen. She used to bring her father to visit a friend in Plymouth and came to see us on the same trip." . . . **Cy Guething** writes that after returning from their southern winter vacation in Delray Beach, he and Gyps "have visited Portugal, Spain, the Greek Isles, the Holy Land, the Far East, eastern Canada, central Canada, New England, Washington State, Victoria, Alaska—both by highway and inland water way—California, Colorado and Yellowstone and many, many other places." He is quick to explain: "Don't want you to believe we have bodily been to all these and more places. Not so! Much better. Without leaving and without all the trials of traveling, we have enjoyed the cocktail hours in front of the colored TV set. These George Pierrot shows are so much better than traveling—there is no comparison. Their pictures are taken under perfect weather conditions. But they have, for the most part, confined themselves to Michigan."

Back in February, we told about one of our 16ers, **Harold Mills,** a near neighbor of ours in Mountain Lakes, as an amateur astronomer. Now we have heard about another classmate astronomer, **Chet Richardson** up in Youngstown, N.Y., in an interesting article in the December 23 *Niagara Gazette.* He was all set to make observations on the 1973 comet Kahoutek but as we all know K. wasn't very obliging. The article reads: "The ability to examine 1973 Kahoutek, the moon, the planet Venus and Saturn's rings on a clear night with a homemade telescope isn't 'spaced out'. A village man, Chester Richardson, has his own observatory ready. Dubbed "mini Mount Palomar," a six-inch reflector telescope is located on East Avenue here in a cylindrical 15-foot high observatory. The telescope stands about eight feet from the concrete floor, topped by a revolving dome on casters. "It is the result of about 400 hours of work, spread over several years," Mr. Richardson, '78 years young' (as he puts it) says. Mr. Richardson who built it by himself and his two daughters, Ruth and Jane Richardson, utilize it all year long, especially on clear summer nights. He is an active farmer who retired as a chemical engineer from Mathieson after 24 years." Several interesting pictures are shown, one is labelled, "Delicate work. Chester Richardson adjusts the telescope in the observatory he built. Tuesday, January 1, should be a good time to see the comet, he says." Another reads: "Open the Hatch. Chester Richardson opens the slot-cover of the observatory which he built near his Youngstown home. In center photo he is shown rotating the observatory dome, by use of a poker. The dome moves on casters. Mr. Richardson makes an adjustment on the telescope as his daughter, Miss Ruth Richardson, watches."

Here's what we call good news coming as it does from our own **Theron Curtis**—"It may surprise you a bit coming from me, but I think this country of ours will keep going despite the Arabs and the politicians." He and Hope reported back in April, "We have just returned from a visit to our favorite old hotel at Clearwater Beach. Had good weather and several swims in the Gulf together. The Red Tide was near us at St. Pete and Tampa Bay but we took a chance and had no ill effects." . . . Sylvia and **Vertrees Young** of Bogalusa, La., indicated in April that they didn't yet know whether they would make the reunion. As Vert says, "We are going out to San Francisco April 20 for a reunion with directors, (presumably Crown Zellerbach, Sec.) retiring directors and 'Emeriti' like myself, returning via Denver and Boulder for a couple of days with Sylvia's nephew and his wife." . . . Word from **Phil Baker** in Grosse Pointe Shores, Mich., mentions he has been at home all winter trying to get rid of a sore leg. But he is glad to report that the daily nurses are now gone. As he says, "Spring will soon be here and better days ahead!"

Here's some sagacious philosophy from **Berthoud Boulton** in St. Louis: "Here's one way I look at life. All of us are over 80 or fast approaching it. For the most part life has been good to nearly all of us. It is my belief that the greatest satisfaction we can have is that we try to repay this debt to life by helping others. For this we need expect no thanks—we are only partially repaying what we owe." Hear, Hear! . . . **Dan Comiskey** of Needham sends a word about several 16ers. "Have run into classmate **Arthur Wells'** son in Wellesley. Arthur is well and retired from his town duties. My son, Dan, lives in Watertown, Conn., and sees the **"Van" Lucas** family frequently. I got my usual greetings from **Joel Connolly** in Tucson." We, too, hear often from Virginia and Joel Connolly, as we have since we got to see quite a bit of them on some of our many consulting trips to Albuquerque in the mid-1960's. Dan asks if you've heard this one; "I recently read in the Boston papers that M.I.T.'s first location was on Summer St. near Arch St.—where the Kennedy men's store is now. I always thought it began at the Boylston St. location. I'm researching." . . . A note from **Val Ellicott** of Baltimore in April says that he regrets he can't make the trip to the reunion by combining it with something else. With reference to last year's reunion picture, he notes that he never knew many '16ers "but the picture

you sent me shows two of them—**Charles Lawrance** and **Paul Duff.**"

**Maury Holland** will not be overseas, as he was last year at reunion time, in Copenhagen at the European Industrial Research Institute where he was invited to address the opening of a five-day conference. Way back in 1938, the I.R.I. was started, as the 1973 I.R.I. folder indicates, "under the auspices of the National Research Council, largely through the efforts of Maurice Holland, then Director of the Division of Engineering and Industrial Research." This year's scheduled meeting in Japan has been cancelled. So says Maury, "I hope and plan to be at the reunion this year, although with a heavy heart, without 'Uncle **Jim' Evans** playing 'den Mother' to the young tigers in Cottage 34 flying the M.I.T. banner. My son, Maury, Jr., now a professor of constitutional law at the University of Indiana, after 10 years at Harvard Law, may join me. He was an expert witness on The Advocates' program on TV from Fanueil Hall some weeks ago. My wife, Marion, passed away a year ago." . . . We have a most interesting story from the *Bridgeport Herald* of April 3. It is pretty much of an account of **Dick Berger's** contributions, along with two pictures. He "launched a one-man cancer crusade against cigarette smoking during World War II" and the author says "I was the first to encourage and publicize his campaign when other newspapers ignored Berger and called him a 'crackpot'." The captions of the two pictures tell much of the story, one reads, "His Eyes Light Up. Berger at home, surrounded by autographed photographs and letters of his late great boss, Thomas A. Edison." The other states, " 'If you Can't Stand the Heat, Get out of the Kitchen'. Bridgeport's famous double for the late President Truman is Richard G. Berger retired stockbroker and former assistant to Thomas A. Edison (shown making like Truman) who campaigned for many years warning that cigarette smoking is deadly dangerous."

So now, take care and do have a pleasant and restful summer. Wherever you are, send a card or note to one of your easy-to-satisfy Secretaries.—**Harold F. Dodge**, Secretary, 96 Briarcliff Rd., Mountain Lakes, N.J. 07046; **Leonard Stone**, Assistant Secretary, 34-16 85th St., Jackson Heights, N.Y. 11371

## 17

Mark your calendar now for our interim reunion at Northfield on October 7 and 8, Monday and Tuesday. By general approval our return is to the lovely Northfield Inn where we have now enjoyed several pleasant times.

At our reunion last fall we voted to present a 1917 red jacket to Arthur Fiedler, conductor of the Boston Pops Orchestra. A recent 50-year class had given one to him which he had worn often as had been commented on from several cities where he and his orchestra had appeared. His jacket had come to need replacement, hence our interest. It seemed too that he had had

*It was at their 50th reunion that the Class of 1922 gave Arthur Fiedler, Conductor of the Boston Pops, the traditional red coat of the Institute's 50-year class. Since then Mr. Fiedler has taken so much pride and pleasure in it that this salute from M.I.T. became worn, even threadbare. Hence a new coat this June from the Class of 1917, presented to the maestro by Stanley C. Dunning (left), Secretary, and John A. Lunn, President. (Photo: Margo Foote)*

ideas of going to M.I.T. and, as he says, would have been in the Class of 1917. So arrangements for measuring were made and on May 22 **Al Lunn** presented the jacket at Symphony Hall with the resulting picture. Mr. Fiedler expressed his thanks and appreciation to the Class for it. An interesting side note developed when he and Al got talking of earlier days when Sue Lunn, under her professional name Susan Williams, frequently accompanied Arthur Fiedler, an accomplished violinist and pianist.

Here is one for those who feel that they get too much M.I.T. mail. **George Henderson** wrote, "I miss all the correspondence I once received regularly from elements of the M.I.T. Alumni Association. I suspect that some may have believed me deceased." Checking developed no reason why George had not received the mailings for he is on the active list. He is back home after his eye surgery and hopes to be at Northfield. . . . **Frank Butterworth** has been asking about the fall reunion dates and expects to be there with his wife.

Several reports indicate that we have moved into the octogenarian era. **Brick Dunham** joined the club by way of a delightful garden party at his home instigated by his three children. The Lunns, Stevens, Dunnings and Jim Flaherty participated. Dad Wenzell, now retired from the World Bank, joined the ranks in April as did Ray Stevens, and in March our Secretary, and records reveal many candidates.

Enclosed with President Wiesner's letter of May to the Alumni there was a sheet showing pictures and telling of alumni in the news. There was a note on 1917's recipient of the Aldrin Scholarship. For those who may still have that sheet you will be interested in Owen Knox's picture, the young fellow with glasses.

**Jack Wood** was in town from San Diego over Alumni Day time to help put together a program to modernize and expand the M.I.T. sailing pavilion. He was a prime mover in originating the pavilion as well as establishing sailing in the Institute's athletic activities. Al Lunn hosted a lunch for Jack, **Ray Stevens**, **Stan Lane** and **Stan Dunning** so more could be learned of Jack's activities. He says that he is going to write up the story of sailing at M.I.T. and it is hoped that he will for it is an exciting story. To touch on a few points, it was Professor **Irwin Schell** who got the idea when, years ago, he observed a few random sail boats on the Charles River Basin and the thought came to him that the basin would make a great recreational area right at our door. He promoted the idea and was aided by Dr. Compton, and Jack Wood got aboard. Over 20,000 of our alumni have been registered in M.I.T. sailing starting from student days. That is a third of our alumni body. Today there are five college sailing pavilions on the Basin. Girl students are an active part of M.I.T. sailing. M.I.T. has practically no gate receipts to finance its athletics and probably offers a greater diversification than any university. Here's looking forward to Jack's story.

**Timothy Weston** has a new address: 180 Low St., Newburyport, Mass., 01950.

Regretfully the deaths are recorded of **Edmond Waechter** on November 14, 1973 at Evanston, Ill.; **George P. Ingleheart** on May 14, 1974 at Greensboro, Vt.; and Colonel **Grafton S. Kennedy** on May 25, 1974 at Baltimore, Md.—**Stanley C. Dunning,** Secretary, 6 Jason St., Arlington, Mass. 02174; **Richard O. Loengard,** Assistant Secretary, 21 East 87th St., New York, N.Y. 10028

## 18

I am happy to report an addition to our list of authors in the person of **Stuart Elliott.** He has just sent me for the Class of 1918, his labor of love entitled *Wooden*

*Crates and Gallant Pilots,* published by Dorrance and Co., Philadelphia, Pa. This book relates his experiences in the U.S. Air Force from May 1917 to the Armistice in November 1918. A foreword by General George C. Kenney describes it as "the first story to appear that tells of the humor, the pathos, the tragedies, and some of the frustrations in the daily lives of the early flyers of World War I." It is a well-written production; the style is breezy yet interspersed with a laconic and pithy wit. You can see the rugged individualist coming from a New England background. I enjoyed his hand-drawn, humorous illustrations. This book will be turned over to the archives of the Historical Collections of M.I.T.

Quoting from the jacket, "Stuart E. Elliott was born in Osterville, Mass., in 1892. A graduate of Harvard and an alumnus of M.I.T., he enlisted in 1917 and served in the A.E.F. as First Lieutenant. An explorer and adventurer, Mr. Elliott has engaged in gold and silver mining in California and Nevada, crewed in a Bermuda schooner race, joined in an Arctic expedition aboard a Norwegian seal ship, as well as travelling extensively throughout the world. In 1942 he rejoined the air force and served in Guam and Japan.

Mr. Elliott and his wife, Alice, reside in San Rafael, Calif., where they lead a rather quiet life enlivened by attending the races.

I am indebted to **Herb Larner**, 1 Crestmont Rd., Montclair, N.J., for his "First Epistle of the Prophet" dated January 7, 1974, "Dear Max, Never having written to you before I am tempted to call this piece 'The First Epistle of the Prophet Herb to the 1918 Technologians.' However, a better title might be "Some Things I Remember."

"Biographical essays can be dull and boring and I view them rather dubiously. One has to research his mind back into the years much too far and common sense suggests that too much looking back is not wise.

"At an M.I.T. dinner in New York some years ago, Dr. Karl Compton told a story that has long been fixed in my memory. His sister, who was the wife of a missionary in India, had hired a native electrician to do a wiring job. He was a man who couldn't make decisions and he annoyed the sister no end by asking her advice about the job he had in hand. At least she told him to use his common sense, whereupon the native made a profoundly wise reply. "Madame", he said, "Common sense is a precious gift of God. All I have is a technical education."

"Nowadays, I like to believe that I have gained a fair amount of common sense. Blessed with a wife who has been a traveler much of her life and who is forever wanting to go somewhere, I've poked my way into a good many strange places here and there about this planet during the last 12 or 15 years and I've met quite a few people whose lives and ideas were vastly different from my own. I've done considerable reading and studying and above all a lot of unpressured thinking. It seems to me that I've learned more during these last retired years than I did in all the rest of my life put together. The consequence is that mentally I feel more competent and better equipped for life than ever before.

"Last September I spent about two weeks in the hospital having one of those operations that senior male citizens sometimes require as they get older. I endured five or six days being overhauled by urologists, cardiologists, radiologists and God only knows how many other 'ologists. Finally they stamped their seals of approval on me and said that I was in good shape for a vigorous workout.

"One morning they gave me a spinal anaesthetic and told me that before the operation it was customary for the patient to tell the doctors a funny story and that I should disregard the presence of the nurses. So I told them all a little story at which the nurses laughed heartily. That made me a member of their club, they said. The operation was about as exciting as having a haircut. It took not much longer although it was more costly. Then I had to stick around for another five or six days just to make certain that the doctors had done their job right. Finally they sent me home under my own steam.

"But all this is incidental to the fact that my spur-of-the-moment decision to have the operation left no time to reserve a private room. So I was obliged to share one with a man who was recovering from a similar operation. This man is a retired fire chief of a well known city and the old chief and I hit it off fine together. I call him the old chief because he is three weeks older than I. Hospitals, as you know, are noisy places. There is the everlasting cacophony of banging bed pans and at night there is always some over zealous nurse with a devilish extra-sensory perception complex who will barge in whenever she divines that you are sleeping peacefully and will insist on rubbing your back or taking your temperature or something. This sort of thing kept the chief and me awake quite a lot and we would sometimes talk until the wee hours of the morning. The chief would regale me with details about the big fires he handled during his 40 years of fire fighting. One night he made a confession that must have delighted the soul of W. C. Fields. He said that all his life he hated to pick up babies and small children. Then he related that time after time he would find himself stumbling out of a burning building with a half-dead youngster tucked under each arm.

"One night while the chief was gently snoring I got to wondering how many people are now enjoying life who never knew, or if they did, never bothered to thank the old chief for saving their lives. It was all in a day's work for him, of course, and he probably never gave the matter a second thought. But the facts made me consider how absurd it is for people to puff themselves up overmuch because of a few professional or business successes. Depending upon what one has done during his lifetime, there are as many ways of expressing one's philosophy about life as there are individuals capable of doing so.

"I remember a time in San Francisco long ago when a few friends and I had dinner at the Olympic Club with that dean of all sports writers,. Grantland Rice. He told us interesting stories about famous sports figures whom he knew intimately and whose careers formed the substance from which he fashioned his writings. "Gentleman Jim" Corbett had been a member of the Olympic Club years before and "Granny" Rice told us what a fine character he was with his courtly manners and strict sense of fair play. Several months later in Rice's syndicated column there appeared a poem which he wrote and which I memorized just because I had met Grantland Rice. Although I don't recall the exact title of the poem, allowing for a lapse of memory here and there, the words went something like this:

Life I consider has one main play
To shrug off defeat and then come back
To work out the calendar day by day
And keep your mind on the uphill track
For without some failures you'll never gain
The fiber needed to face the strain—
Only those who have suffered know
The needed strength when the road is rough
Scars not medals are what you show
The coach out looking for winning stuff
There is no royal road to the top of the hill
Which leaves you at last with the winning thrill—
Scars are the test when the game is done
Where fame is only a phantom fad
It matters not who lost or won
Where all have given the best they had
Only the beaten and battered rate
An even chance against hostile fate.

"That pretty well sums up the credo of Grantland Rice. Mine is a little shorter and reads—Hats off to the past and coats off to the future.

"So I'm working out the calendar day by day and I'm keeping my mind on the uphill track. For who knows how long that hill is or how far up you're supposed to go. For all I know there may be some unfinished business I'm supposed to complete before it's time for me to be retired to my estate called Mount Auburn, just across the river from you, and only a stone's throw from the place where I was born. If anything like that happens to me II'l let you know about it through 'The Second Epistle of the Prophet Herb to the 1918 Technologians.' Best wishes for 1974, Herb Larner."

I wish all of you could read the article in the *Sun Magazine* section of the *Sun Baltimore* edition of February 24, 1974 entitled "Thirty Acres and a House on a Terraced Knoll in Phoenix (Maryland)." It is a charming description of Frances and **Pete Harrall**'s residence. It is located on a hilly countryside with a commanding view above a series of terraces, a spectacular build-up. Like tiers of an ampitheatre each of the four banks is retained by a wall of over 4000 railroad ties, 10 feet wide and graduating in height from 6 to 8 feet. The top level is bordered by a thick hedge of juniper.

The place name on the entrance doorway sign is "Nepenthe" a word the ancients wrote to express a state of well being, free from care and sorrow. If you could see the pictures accompanying the article I am sure you would agree the Harralls have created a home worthy of its title. I am very happy to report from Jim Killian's office the receipt of a very substantial gift to the M.I.T. Alumni Fund from **Carl Blanchard**, New Haven, Conn.

With sadness I record the passing of Dr. **Ross Salisbury** and **Ed Rogal**. The *New York Times*, Thursday, May 9, 1974 DeRoss Salisbury Is Dead; Pipe-organ Designer, 88.

**DeRoss Salisbury**, a designer of pipe organs who has been associated since 1946 with the Schantz Pipe Organ Co., died Tuesday in Bellvue Hospital. He was 88 years old and lived at 124 Ancon Avenue in Pelham, N.Y. Among the installations Mr. Salisbury made were the pipe organs of St. Andrew's Episcopal Church, the Park Avenue Methodist Church, the Church of the Holy Communion and the Reformed Church in Bronxville, N.Y.

Mr. Salisbury graduated in 1918 from M.I.T. He was later Vice President of the Intertype Corp. Surviving are his widow, the former Stella Harp; a son, the Rev. DeRoss Salisbury Jr.; a daughter, Mrs. Judd D. Grey, and five grandchildren.

**Edward Rogal** passed on April 28, 1974 in Scituate, Mass., after a lengthy illness. He served in the U.S. Air Force in both World War I and II. After World War I he returned to M.I.T. to continue research in the electrical engineering department. In the early twenties he joined in the family furniture business. Here he developed the point of sales system—the forerunner of the automatic computerized systems now being used for inventory control particularly by large department stores. He supervised the first installation of this type in the thirties at Kaufmans in Pittsburgh. After World War II he continued invention and developments in this field, serving as a consultant to many large industrial clients until forced to retire due to ill health about a year ago. His widow Laura to whom we extend our sympathy has written us that M.I.T. meant much to Eddie. I am sure she will agree that that indicates as well that we of class of 1918 mean much to each other.

Change of address: James M. Bugbee, 115 Hawthorne Rd., Baltimore, Md. 21210; Stanton L. Burgess, Prospect Towers, 801 Chestnut St. #908, Clearwater, Fla. 33516; Chung Yang Chen, 7 Lane 17, Ho Chiang St., Taipei, Taiwan; J. Alston Clark, Apt. B, 232 Court St., Clarksdale, Ms. 38614; Eaton J. Clougher, 10 Shorelands Drive, Madison, Ct. 06443; Robert T. Collier, P.O. Box 158, Escalon, Calif. 95320; William L. Collins, 1583 Washington St., West Newton, Mass. 02165; Marion L. Cousens, 316 Shadeland Ave., Drexel Hill, Pa. 19026; Philip B. Craighead, 15 Orchid La., West Yarmouth, Mass. 02673.—**Max Seltzer**, Secretary, 60 Longwood Ave., Brookline, Mass.; and **Leonard Levine**, Assistant Secretary, 519 Washington St., Brookline, Mass.

# 19

Our 55th Reunion May 31-June 3 will have been, and will be reported in the next *Review*. At the time of this writing 35, including many wives, have signed to attend. They were **Ray Bartlett, George Bond, Jr., Horace Denison, Ev Doten, Ed Flynn, Maurice Goodridge, Lou Grayson, Alfred Hough Will Langille, George Michelson, Ed Moody, Russ Palmer, Paul Sheeline, Gene Smoley, Chester Stewart, Jim Strobridge, Carl Svenson, Don Way, Dean Webster, Francis Weiskittel**. Others no doubt decided to come also at the last minute.

From the Alumni Association are the following addresses: Pierre Blouke, P.O. Box 411, Chatom, R.I. 36518; Henry B. Blumberg, 17 Leewood Circle, Tuckahoe, N.Y. 10707, Nelson A. Bond, 2114 Rankin Rd., Schenectady, N.Y. 12309; Benjamin Bristol, 28 Union St., Foxboro, Mass. 02035; Dugald W. Campbell, 12532 Morningside Ave., Apt. 2, Garden Grove, Ca. 92640; George W. Cann, 900 Youngsford Rd., Gladwyne, Pa. 19035; John S. Carter, 68 Winnifred Rd., Brockton, Mass. 02401; Rogers B. Johnson, Box 35, Franklin, N.H. 03235.

Notes were received in April from several classmates. **Ev Doten** says "News will be cleared when we get together for our 55th at Chatham Bars Inn on May 31st." . . . **Louis Grayson** writes, "My wife (Aline) and I are looking forward to our reunion at Chatham Bars Inn. Last October we again spent in eastern Canada and New England. We took a trip over to Gardner Lake where I spent the summer of 1916. It is falling to pieces."

**Edward E.** (Ted) **Saunders** says, "Mrs, Saunders and I (we have our 52nd anniversary this year) live in Carl Vinson Hall with over 225 retired couples, widows of officers and retired officers of Navy, Marine Corps, Coast Guard plus a few residents with similar connections to the other services and state department." . . . **Leighton B. Smith** writes, "Except for another two weeks in May of bird photography in Utah and our usual two weeks of trout fishing in Maine in early September we haven't strayed far from home."

*The Star* (Winchester, Mass.) on March 28, 1974 had an article with photograph of **Carl E. Thomas**. Carl was born in Cambridge, Mass., in 1898 and studied Course II in the Class of 1919 and served in the Royal Canadian Air Force during World War I. He returned to M.I.T. and received his B.S. in physics then went with Automatic Refrigerating Company of Hartford, Conn. In 1922 a laboratory accident resulted in his loss of sight. "Despite this handicap, he returned to Harvard University where he received his M.B.A. (cum laude) from the Graduate School of Business Administration in 1924 and a Ph.D. in economics in 1935. During the period 1928-29 he received the Sheldon Fellowship in the London School of Economics. From 1935-1959 he served as economic advisor to the Lehman Corp., of New York. From 1944-1964 when he retired he was an economic consultant to the John Hancock Mutual Life Insurance Company of Boston."

His papers, including his chief work, *The Dynamics of Nation Building*, a five volume manuscript concerned with his theories relating to the economic causes and effects of war in Anglo-American history, were added to the Baker Library at Harvard University Graduate school of Business Administration.

Best wishes for a pleasant summer to the Class.—**E. R. Smoley**, Secretary, 50 East Rd., Delray Beach, Florida 33444

# 20

Among those attending the 26th M.I.T. Fiesta in Mexico last March were Evangeline and **"Count" Dumas**. It was pleasant to see their names and think of them having a good time in the sunshine of this marvelous annual gathering. Let's more of us try to make it in the year of our 55th!

A card from our **Norrie Abbot** from Luxembourg tells of his and Betty's visit to five of Denmark's 500 islands and to Brussels before starting on their third Swissair railroad excursion. More power to them. . . . **Harold Smiddy** writes of his attendance at a gala 75th birthday party at George Dandrow's home in Bronxville. **Frank Bradley** was also there to help celebrate this auspicious occasion. We think of the many good times we enjoyed with George at our past reunions and only wish he hadn't backslid to another, lesser class. Anyway, we wish him many happy returns.

Lois and **Harold Smiddy** recently attended commencement exercises of Manhattan College in Madison Square Garden at which Harold was awarded the degree of Doctor of Laws. His citation contained the following comments, "Harold F. Smiddy's career is one that chronicles years of development, growth and service. He graduated from M.I.T. and immediately moved swiftly up the managerial ranks as service engineer, assistant distribution engineer, assistant to the commercial manager and Vice President and operating manager at Pittsburgh's West Penn Power Co. His talents for combining excellence in engineering and management lead him to the directorship of Ebasco Service Inc., general partnership in Booz, Allen and Hamilton, and eventually to a vice presidency at General Electric Co. Today, Harold Smiddy is among the country's foremost executive management consultants, boasting numerous industries, colleges, universities and foreign countries among his clients. He has devoted countless hours to the growth of his profession and higher education in general. An active member of the Society for the Advancement of Management, he received its coveted Taylor Key in 1953. He is a member of the Foundation for International Progress in Management, life member of the Academy of Political Science, a former first Vice President of the Pan Am Council, Trustee of Ithaca College and member of Manhattan College's Business School Advisory Council, and a visiting professor in its 'Frontiers of Knowledge in Business' lecture series.

Harold Smiddy is surely a captain of industry." Harold, we are proud of you and your achievements.

Word has been received of the death last summer of **David A. Reed, Jr.**, formerly of Brevard, N.C. His death occurred at New Hampshire House, Hanover, N.H.—**Harold Bugbee**, Secretary, 21 Everell Rd,. Winchester, Mass. 01890

# 21

Our thanks go out to **Al Lloyd** and **Bob Miller** for their reports of the memorial service for **Ted Steffian** held in the Bigelow Chapel at Mt. Auburn Cemetery on April 29. The Class was represented at the service by **Elliott Adams**, **George Chutter**, **Ed Dubé**, the **Mel Jenneys**, the **Al Lloyds**, the **Dick McKays**, and **Bob Miller.**

An I.E.E.E. news release sent to your Secretary from M.I.T. announced the election of Kendall Preston, Jr., to the grade of Fellow, effective January 1, 1974. An inquiry to **Kendall Preston** of Greenville, N.H., brought forth a reply that the newly elected Fellow was indeed Commander Preston's son and "I am very proud of him." Kendall Sr., graduated from the U.S. Naval Academy in 1915, served overseas on a battleship operating out of Scapa Flow and later on a destroyer operating out of Brest. He got a S.B. degree in Course II with our Class in 1921. His last active assignment was in World War II at the Quincy Shipyards as Naval Inspector of Ordnance. "We turned out the U.S.S. *Massachusetts,* many carriers, cruisers and destroyers—those unfamiliar with shipyards will never know the miracles performed by this yard during the war." Commander Preston now classifies himself as a country squire on a hilltop in New Hampshire. His greatest pleasure is skeet shooting but he is also an avid gardener and past vestryman of All Saints Church in Peterborough, designed by Ralph Adams Cram—"one of the lovely small edifices in the country. Don't fail to visit it." Kendall also reported that **Fairfield Raymond** lives nearby in Happy Valley, Peterborough, "a wonderful fellow and up to his ears in civic projects."

A letter from Assistant Secretary **Josh Crosby** enclosed a number of snapshots taken at the mini-reunion luncheon at Bardmoor in February. Josh reports that the M.I.T. Club of Southwest Florida had their annual spring picnic on Casey Key in April. A beautiful day on the Gulf brought out a full table of 21ers which included Beth and **Whittier Spaulding**, Bee and **Tom Dutton**, Kay and **Ed Delany**, Millie and **Herb Kaufmann** and Claudia and **Josh Crosby.** The Delanys attended the open house on April 9 at Fort Myers which celebrated the golden wedding anniversary of Marion and **Phil Payson.**

Alumni Fund envelopes brought welcome news from three classmates. **Harry M. Ramsay** of Escondido, Calif., wrote in March that he had lost his second wife a few months previously after 22 happy years and now had remarried his first wife—the mother of his three children. Quoting Harry, "It's unusual to marry the same year as your 50th anniversary—I recommend it to anyone! . . . **Roy A. Wehe** of San Mateo, Calif., writes that he is still busy in his consulting practice, testifying before Public Utility Commissions in Nevada, Utah, Wyoming, Idaho and California. Roy was recently appointed a member of the Public Works Commission of San Mateo after previously serving as a member of the City Council. Your Secretary recalls with pleasure the delicious lunch that he and Grant Miner had with Grace and Roy Wehe last October. . . . Professor **Roy J. Campbell** reports that he retired in 1967 as Professor of Biology at Salem College, Winston Salem, N.C. He now lives at Robinhood, Georgetown, Me., actively working on the buildings on his property, fishing for striped bass and lobstering on a small scale—"get mostly crabs."

Speaking of **Grant Miner**, a most interesting letter came in from him telling of their spring activities in Los Altos, Calif., "Planted three or four new trees and lots of shrubs—battling the weeds—Marianne practicing on the piano every day. Haven't had time to go up to Wells Fargo in San Francisco to check up on my cousin, Billy Miner, the highwayman, but it's on the agenda and I'll give you a run-down." (Let us hear more.) Grant enclosed a 1933 Los Angeles price sheet cut from a newspaper right after he and Marianne were married: (read 'em and weep! ) lemons, 2 dozen, 5 cents; Jonathan apples, 8 pounds, 25 cents; large head lettuce, 1 cent; frankfurts, 2 pounds 25 cents; porterhouse steak, 27 cents a pound. Ah, me! These, of course, were tough days and Grant's cousins in Iowa lost their farm because corn at nine cents a bushel made it impossible to keep up payments.

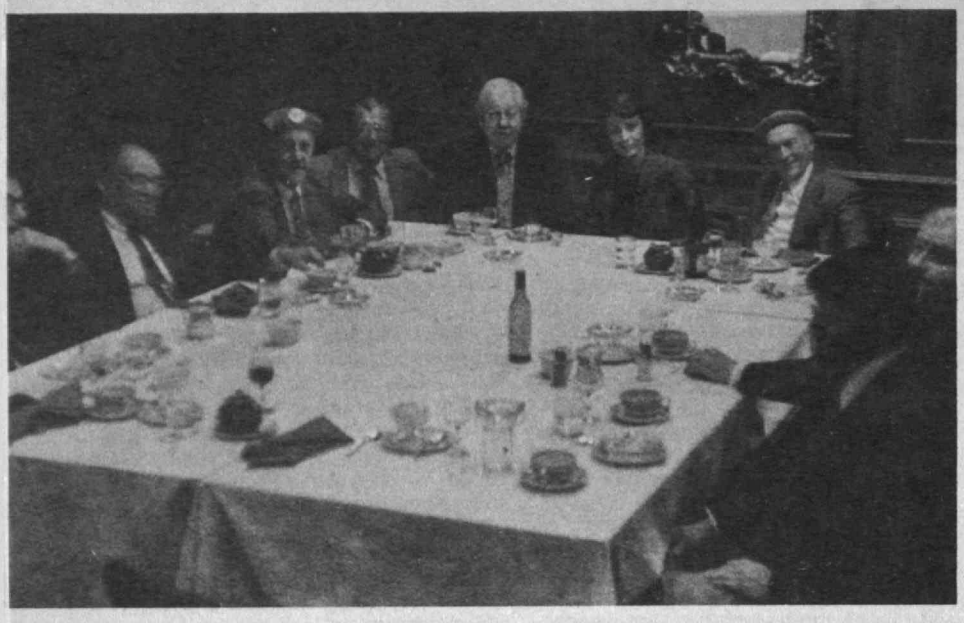
Heading north in late April for their summer cottage on Cape Cod, Helen and **Bob Miller** met the Haywards, **Joe Wenick** and Cecelia and **Arnold Davis** for lunch in Upper Montclair, N.J. Bob delivered by hand, copies of the montage of 112 classmates that he and **Laurence Buckner** had prepared. It is a wonderful memento of our 50th Reunion and Bob's initial print order of 100 copies is exhausted. If enough additional copies are ordered, Bob will put in an order for additional prints. . . . Your Secretary was privileged to read congratulatory notes to Bob and Buck from **Dave Woodbury** of Ogunquit, Maine and Class Agent **Ed Farrand** of La Jolla, Calif. Said Dave, "Magnifique! Congratulations. I'm still working at the old stand in my upcoming 78th year and only moderately worse for wear. Regret exceedingly I was flat on my back in the hospital at time of the 50th Reunion." . . . **Arnold Davis** reported at lunch that he is doing no consulting work but had recently completed painting both the inside and outside of his house. Arnold retired in 1965 from American Cyanamid where at his big retirement party he was affectionately labelled "Mr. Rubber Chemicals."

A recent letter from **Helen St. Laurent** told of a surprise visit in early May from Emma and **Al Lloyd**, Marion and **George Chutter** and Helen and **Bob Miller**. The Chutters and the Millers were spending the weekend with the Lloyds in Westerly, R.I. and decided to drive to Manchester, Conn., to join Helen for lunch. Bob Miller, of course, had his camera along so we hope to get a picture of this occasion for the class archives. Helen also noted her delight in having the Buckner-Miller class picture, "such a fine memento of a glorious 50th Reunion." An amusing newspaper clipping enclosed in her letter with a heading "M.I.T. Offering Fun Courses", listed courses given in January as part of the independent activities program; how to pedal a unicycle, how to blow soap bubbles and how to produce home-made beer. Did we go to M.I.T. at the wrong time?

The M.I.T. Club of Northern New Jersey had its annual dinner meeting on May 15 with M.I.T. Vice President Kenneth Wadleigh as the featured speaker. Attending from our Class were Dorothy and **Joe Wenick**, Maxine and Secretary-Treasurer-Emeritus, **Cac Clarke** and Betty and **Sumner Hayward.** The Clarkes sat at the head table and Cac made a presentation of a corsage to Ken Wadleigh's mother. Thirty-five years ago Cac as an Honorary Secretary interviewed Ken Wadleigh as an applicant for admission to M.I.T. Apparently Ken made the grade. Cac is still active as Chairman of Brielle's new historical society which is busy with plans for the Bi-Centennial celebration in 1976. Cac continues as a contributor and rewrite man for the *Coast Star* (Manasquam, N.J.). Maxine is currently having a one-man show of her Mexican Paintings at the Monmonth County Library.

With sorrow we record the deaths of three more men from the Class of 1921: **A. Cameron Hayden** of Exeter, N.H., on April 1, 1973, **Winthrop E. Luke** of Belmont, Mass., mid-April, 1974, **Romney J. Mellen** of El Paso, Texas on April 30, 1974. Cameron Hayden worked for many years for the Factory Mutual Insurance Co., Engineering Division, in Boston, before retiring to New Hampshire.

Winthrop Luke was employed by Stone and Webster during World War II and while there was presented with a citation from the Secretary of War for work on production equipment for the atomic bomb. After the war, Win was head of the architectural department of Wentworth Institute from 1947 to 1951, following which he was architectural engineer at the Watertown Arsenal until his retirement in 1966. . . .Romney Mellen worked for many years as a metallurgical engineer for American Smelting and Refining Co., where he was Chief Metallurgist of the Mexican department at his retirement in 1962. He and his wife, Fern, celebrated their 50th wedding anniversary last year. The sympathy of the Class goes out to the families of these three classmates. We are indebted to Norman Weiss, '23 for information regarding Romney Mellen.—**Sumner Hayward,** Secretary, 224 Richards Rd., Ridgewood, N.J. 07450; **Josiah D. Crosby**, Assistant Secretary for Florida, 3310 Sheffield Cir., Sarasota, Fla., 33580; **Samuel E. Lunden**, Assistant Secretary for California, Lunden and Johnson, 453 South Spring St., Los Angeles, Calif. 90013



*Two pictures to prove that Dale D. Spoor, '22, is everywhere when he comes back to M.I.T. He is third from the left in the top picture, taken at the M.I.T. Faculty Club during a strategy session of the Class officers with the occupants of the Class of 1922 Professor ship and Career Development Awardees. Left to right around the table are Arthur P. Mattuck, the current Class of 1922 Professor in mathematics; Walter A. Rosenblith, Provost; Mr. Spoor; Parke D. Appel, '22, President of the Class; Roy Lamson, former Class of 1922 Professor in literature; Margaret L. A. MacVicar, '64, Assistant Professor of Physics who now holds the Career Development Award of the Class; Donald F. Carpenter, '22, Senior Vice President of the Class; John Wulff, former Class of 1922 Professor in metallurgy; Paul E. Gray, '54, Chancellor, formerly Class of 1922 Professor in electrical engineering; and Joseph Ferreira, Assistant Professor of Urban Studies and Operations Research.*

*In the lower picture, Mr. Spoor is shown with friends and classmates at the cocktail party concluding Alumni Day on June 3.*

# 22

Having safely returned from Morocco, Portugal and Spain, your Secretary can now report on how to conduct a revolution in Lisbon. First get a nice suite on the 10th floor of the Ritz Hotel and then relax for the extra four days that the airports and borders are closed. We traveled without restraint to Fatima and Nazare. Also on another day to Sesimbra and the fishing villages to the south. The crowds were boisterous but happy and the soldiers were not threatening even when carrying machine guns. The people seemed so overjoyed to get away from the dictatorship that they simply celebrated over the weekend while opening the prisons for political prisoners and allowing the exiles to return. We hope that General Spinola will successfully complete the political reorganization he has planned and solve the problem of the African Territories. . . .A postal card from **Parke Appel** dated May 8 told of his journey to Malaga in Spain and visiting his daughter during their 50th wedding anniversary. They took trips to Andalusian, Spain, to Toledo, Seville, Granada, Malpica and the Costa del Sol. After their cruise of the Greek Islands, they plan to fly to Boston to be with us during Alumni Days after which they will return to Venice, Fla., by way of Richmond "with **Dale Spoor.**"

Colonel **A. G. Silverman** has retired from the office of Secretary of Defense. The Silvermans' visited their daughter in Paris where she is completing her doctoral studies in psychoanalysis. Their son is a doctoral candidate at the American University in Washington. . . . **Donald F. Carpenter** has listed his guests for dinner after graduation including Professors John Wulff, Roy Lamson, Paul Gray, Arthur Mattuk, Margaret MacVicar, Joseph Ferreira and Arthur Rosenblith. This will allow many connected with the '22 Chair to meet some of our class members. . . .We want to congratulate **Everett W. Vilett** and Janice of Short Hills, N.J., for attending the 1974 M.I.T. Fiesta in Mexico. We would love to receive their report. . . .We have received a most comprehensive book by **Robert P. Ramsey**, Mt. Vernon, Ohio entitled: *On The Road to Riches Or If You Get Off A Few Times Get Back On.* To report completely on the contents including figures, curves, models, budget and plans would require complete publication. We highly recommend it.

We have reported the death in February of architect **Albert Kruse** who had retired, but continued as consultant on historical preservation projects. He had prepared the study for the historical area in New Castle and supervised restorations there. He was a consultant and architect for many houses and historical villages. He was an illustrator and did watercolors and lithographs and was former President of the Delaware Chapter of the American Institute of Architects.

The sympathy of our Class is extended to the families of General **William Francis Heaney**, Washington, D.C.; **Charles H. Chadbourn**, Minneapolis,

Minn.; **Louis J. Caldar**, Woodsville, N.H.; **Kenneth R. Sutherland**, Wellesley, Mass.

Among the changes of addresses reported are John A. Blaker, Auburn, Mass.; John O. Bower, Shelborne, Nova Scotia; Professor Edward L. Bowles, Wellesley, Mass.; Charles H. Bradley, Mobil, Ala.; Carl B. Braestrup, Guilford, Conn.; Charles C. Bray, Western Springs, Ill.; Charles E. Breitbeil, Louisville, Ky.; Clinton B. F. Brill, Tallahassee, Fla.; Charles E. Brokaw, Denver, Colo.; G. Piers Brookfield, Forest Hills, N.Y.; Daniel A. Brown, Jr., Pocasset, Mass.; Gunnar Brun, Lillestrom, Norway; Douglas M. Burckett, Lincoln, Mass.; Lee W. Carroll, Newark, N.J.; Rupert S. Carven, Jr., Weston, Mass.; Norman J. Greene, Newtown Square, Pa.; Colonel Paul C. Howe, New Port Richey, Fla.; Aubrey K. Nicholson, Stuart, Fla.; John S. Raffety, St. Paul, Minn.

May your summer be pleasant after our reunion in June and the annual class check-up. "Annual class reunions are off to a roaring start, when everyone gets together To see who's fallen apart." —**Whitworth Ferguson,** Secretary, 333 Ellicott St., Buffalo, N.Y. 14203; **Oscar Horovitz,** Assistant Secretary, 3001 South Course Dr., Pompano Beach, Fla. 33060

# 23

The big news is that "A GREAT HISTORY OF THE GREAT CLASS OF 1923" is complete, shipped and by now in the hands of those who have ordered it. It is truly a great work and we owe much to the hard work, diligence and unfaltering efforts and faith of Phyllis and **Dave Davenport** who, in spite of the lack of enthusiasm and support from most of us, carried this effort on to a most successful conclusion. There are over 1050 biographies of our classmates which is an extremely high figure considering the number of years that have elapsed and the wide dispersion of habitats and the number of deaths that have thinned our ranks. We must also recognize some 30 odd classmates who contributed much time and effort in whipping the biographical data into shape. Some of us, I know, may have been reluctant to spend the money for this great book but I can truly say that it is worth every penny of the $27.50 that we paid for it, that is, for the first edition so to speak. If you have not ordered one to date you may be obliged to pay more than this figure. Communicate with Dave Davenport at P.O. Box 574, Virginia Beach, Va., 23451 for further up-to-date advice. Many thanks to you Phyllis for your superb help and encouragement to Dave. Without you we know that the book would not have the professional polish that it truly shows. There are a few minor typos here and there but we are willing to bet that these existed on the original copy sent to you. We should also be very thankful for the support and help of the Alumni Office staff under Don Severance's supervision. I know that we can truly state that the Class of 1923 has made another "first" in the publication of what may well be the first class history of any graduating class since the founding of M.I.T. We also applaud the many contributions of Henry B. Kane, '24, to the book. . . From Professor **Richard H. Frazier** in a letter to me we quote "The Class History is an elegant and mountainous job, and I shall write Davenport presently to compliment him. The reading reminds me that since sending in my biographical material I have acquired a second granddaughter, Sarah Elizabeth Jones of Windsor, Conn. Further, as you will see from the enclosure, the Quarter Century Club at M.I.T. has decided that the faculty is around to stay, and now even is initiating emeriti, so that I have been awarded an M.I.T. chair and a pin. Being practically ready for the Half Century Auxiliary (having come on to the staff in 1925), I told the club president that I expect a rocking chair next year, though as you will also see from the enclosure, I still have been quite active in the Draper Laboratory." Good to hear from you Dick. We will correspond further since I too had an association with Doc Draper's Lab through my former connection with the Barden Corporation which did much contract work with Doc's operation.

Through the good offices of Russell W. Ambach, Secretary of the Class of 1924, we learned of the death of **Raymond T. Willis** of Saunderstown, R.I., on April 18, 1974. In due course his son, Professor Jack Willis of the University of Rhode Island, sent me the obituary clipping and further information. Ray was a telephone engineer for some few years after graduating with us. He was a resident of Saunderstown for 45 years and successively became a boat builder, cabinet maker and commerical fisherman. We are also impressed with the fact that Ray became a self-taught artist in oils beginning in 1969. He was a member of the Wickford (R.I.) Art Association and had considerable success in selling his paintings of marine and ship subjects. He is survived by two sons, Jack and Philip, and eight grandchildren.

**Gladys Farmer Noble** writes, "no great contribution to the scientific world. Live an active life; my husband and I walk four miles each morning before breakfast. . . and during summer months water-ski every day. Have given nearly 7,000 volunteer hours at a local hospital." Nice to hear from you Gladys. We remember you well from the days when co-eds were not so numerous as they are today. . . **Philip S. Wilder** says, "I pass along my copy of *Tech Review* to the Biology Department of Bowdoin College. There are M.I.T. alumni in the Departments of Chemistry, Physics and Mathematics (here)."

We learn fragmentally of the deaths of two classmates, **Anna A. Mohring** of Flushing, N.Y., on February 12, 1974 and Captain **Floyd A. Tusler** of Springfield, Va., on March 13, 1974. Tusler was one of our naval officers, getting his M.S. in Naval Construction and Engineering with our Class. His career was for the most part in the navy from which he retired in 1948 after a tour of duty in the Bureau of Ships. After retirement from the navy he was Chief Engineer of the United Engineering Co., of Alameda, Calif. (We are finding much data in Davenport's "Great History"; so why not break down and get one, it is fascinating reading!—**Thomas E. Rounds,** Secretary-Treasurer, 990 A Heritage Village, Southbury, Conn., 06488

# 24

While legging it to the Alumni Office to settle more details on our Plymouth get-together, by accident, the *Review* staff informed me that they wanted Notes for this issue. Fortunately, **Nat Schooler**'s good wife, Freda, had sent me a note confirming the great work Nat had done for the Gift committee. With it came a newspaper clipping about **Bill Risenwald**, his good friend and a distinguished member of our Class.

On February 7, 1974, Bill was honored for 40 years as an "incomparable philanthropist" for raising more than a quarter billion dollars for the United Jewish Appeal and the Federation of Jewish Philanthropies. The tribute was marked with tears and joyous laughter by over 400 leaders. Among the laudatory addresses was a tape-recorded message from Golda Meir, "Bill's friend." Also celebrated was his 70th birthday.

**Ed Sheiry** writes, "I retired on October 30, 1972, and sold my little Hose Booms, Inc., retaining half interest in the six patents on the marine hose-handling equipment I invented and sold in the U.S.A., England, Panama and Peru."

I regret to report the passing of four classmates. **George H. Arapakis** received his master's degree in electrical engineering. Apparently, he joined Consolidated Edison of New York before 1949 and remained until 1965. His last address was La Palma, Calif., his death being reported in October 1972. . . . **John L. Del Cardaye** died on April 3, 1974 in Hylas, Va., according to information from his widow. He was a mechanical engineer and copywriter for Cargill Wilson and Acree, Inc., Richmond, Va. At one time, he was on the advertising staff of Lord and Thomas, New York City. . . . We have word from the widow of **Burton F. Lewis**, Colonel U.S.A.F. Retired, that his death occurred on March 27, 1974 in Ocean Springs, Miss. He enrolled in aeronautical engineering and it appears that his career was in the air force. . . . The Alumni Fund reports the death of **Victor J. Moyes** in Rochester, N.Y., on March 20, 1974. Our records indicate that Vic's entire career was with Eastman Kodak Co. He received his master's degree in chemical engineering and was a member of Alpha Chi Sigma Honorary Chemical Fraternity. He held the unusual position of Curator. Patent Department Museum of Eastmen Kodak. The sympathy of the Class is extended to their bereaved and loved ones.

**Stanley A. Higgins** sends an energetic note. "Do not know it I can get to the 50th Reunion as I am still working. Am Resident Engineer with Anderson-Nichols and Co. Have been on water and sewer-main jobs in New London and Sunapee, N.H. Will start an urban renewal job in Haverhill, Mass., in a few days." . . . A

major public symposium on the development of physics during World War II was presented at the University of California-Berkeley on May 3 and 4. On the panel for discussion after the talks by distinguished science historians was **Fred Terman**, Professor Emeritus of Electrical Engineering at Stanford, who headed the radar counter-measures laboratory during the war.

**Alvan Fisher** has taken the time to prepare superb bibliographies of members of Course VI-A who graduated with us, in collaboration with **Jim MacLean**. They tried for a VI-A reunion during our 50th, but when formulation seemed questionable, they completed the bibliographies. Their efforts revealed that of the 28 graduates, seven had passed away and four failed to reply. I certainly appreciate Skippers' and Mac's contribution to my files. . . . **Dave Kanter** in Great Neck, N.Y., must have had his E.S.P. tuned in on Al, for he sends me his vital statistics stating that after 40 years in the manufacturing and distribution of children's footwear and men's comfort shoes, he retired. He has also done some consulting on hydraulic and pneumatic systems. His three children did remarkably well in college and are leading very successful lives. Such accomplishments are a great satisfaction to all of us whose children have rewarded us for sometimes trying years.

**Paul Cardinal** and **Clint Conway** have screened our new 1924 directory and call several apparent errors or omissions to my attention. At the moment, I have not the time to look into the shortages and encourage you to bring to my attention, knowledgable facts for the Alumni Record. . . . We had regrets for non-attendance at the 50th from **Jimmie Doolittle** and **Eric Brater**. Jimmie seems to have had all the travelling that he can take and Eric has had an illness problem in his home.

To end on an exhilarating note, **Luis Ferré's** exhibition of paintings on loan from Museo de Arte de Ponce Puerto Rico Fundación. Luis A. Ferré presented rare opportunity for reappraisal of French main-stream artists, masterpieces of the Pre-Raphaelite Brotherhood, the Barbizon School and little-known Puerto Rican artists, whose works have been judged by Luis and art connoiseurs as typical examples that should be preserved. I sincerely hope that each of you obtained the excellent brochure "Nineteenth Century Paintings" depicting the exhibition organized by the Hayden Gallery and sponsored by the M.I.T. Committee on the Visual Arts. Members of the Class have asked me to publicly express their appreciation to Luis for his very thoughtful gesture in an excellent luncheon.

**Paul Blampied** returned from his third 'round the world trip on a freighter May 21. He did not set the world on fire, but the boat did in the Persian Gulf, where he had to spend 10 days during repairs.—**Russell W. Ambach**, 216 St. Paul St., Brookline, Mass. 02146

## 25

Just to orient you, I am writing these notes in mid-May, so much water will have gone over the dam before you receive them. First will be Alumni Days at which I hope to see some of you and shortly thereafter my wife and I will be off on another trip to the Canadian Rockies.

I received a note from **Sam Spiker** in which he noted certain sins of commission on his part and asked me to put in a plug for the 50th Reunion and the Class Gift. We do not have too many members who are in a position to make substantial gifts and what we need are many small and medium ones. As Sam puts it, this is a "Once in a Lifetime Opportunity." Referring to the reunion, you will also have received a letter from **Jim Howard** urging you to attend and sign up now for the big event. I see that free dormitory rooms are provided at the Institute. Let's make them provide overflow facilities.

A communication from the M.I.T. Club of Mexico City indicates that **Harrison Browning** attended their annual Fiesta in Mexico. . . . **Archer M. Nickerson** writes that he has now reached his three score and ten. He states that his time is not long enough due to unsolicited consulting assignments on marine auxiliaries, offshore mooring of drilling rigs, considering a waiting list of restoration of antique clocks, chores, growing things, writing, boating, family and friends, also to provide a little time for just sitting. . . . **Ed Harris** sends an interesting account of a three-month cruise on a Norwegian freighter to the Orient. It actually lasted four months because of the oil shortage which caused a partial delay. In Japan there was NO gas or oil shortage. There was real excitement when their ship rescued 32 men from an exploding oil tanker in the middle of the night. The tanker was unable to send an S.O.S. and by luck they sighted the blaze from 20 miles away. He hopes to see us at the 50th.

I am sorry to have to report the passing of **Curtis W. Chapin** of Bridgeport, Conn., on February 12, 1973 and of **Laurent C. Roy** of Needham, Mass., on February 13, 1974.—**E. Willard Gardiner** (W.II), Secretary, 53 Foster St., Cambridge, Mass.

## 26

If we never admitted a gloomy drab day at Pigeon Cove you might distrust our occasional superlatives. Today *is* a cold wet rainy spring day but its great for the lawn's recently seeded bare spots. And a visit to our little sailing club on the harbor found the members of the fleet clustered around the huge stone fireplace sipping coffee and testing cakes prepared by the wife of a young airline pilot. It was so tempting inside that we left our Bullseye tied up to the float to sail back to the Cove on a nicer day. We have been saving a quotation for a day like this. It is from a letter written in July 1856 by Ralph Waldo Emerson upon his return from Pigeon Cove and is now in a bronze plaque overlooking the sea.

*The events of the reunion of the Class of 1924 on June 1-3 will be recounted by the Secretary in the October/November issue of this magazine. To whet your appetite, here are three photographs: members of the Class admiring Luis Ferre's paintings in the Hayden Gallery, the Reunion Gift Committee watching Edward J. Hanley, their Chairman, presenting the $670,000 gift to President Jerome B. Wiesner; and two members of the Class at the Council for the Arts' luncheon for Mr. Ferre on May 31.*

"And behold the sea, the opaline, plentiful and strong yet beautiful as the rose or the rainbow, full of food, nourisher of men, purger of the world, creating a sweet climate, and, in its unchangeable ebb and flow, and in its beauty at a few furlongs, giving a hint of that which changes not, and is perfect."

The above was written before retiring last evening and the clippings were arranged from assembling today. However, a 3 a.m. telephone call brought news of the passing of classmate **Edwin W. Southworth** who also is my brother-in-law. Consequently this part is being added on a jet enroute from Boston to Tampa and a few of the clippings are being sent along to Class Notes Editor Margaret Kelly to assemble for us and complete this issue. Win had been a career engineer starting with the Boston M.D.C. in 1926 and finishing with the city of Tampa a couple of years ago. We expect to be at Pigeon Cove all summer and hope some of you including friends in other classes, will stop by.

The clippings referred to are these. We recently had a nice letter from **Carl Nelson** in which he recalls one of his engineering accomplishments of many years ago. Carl thought the Class might be interested in how he stopped vibration in a hotel building. "Some years ago I was called upon to stop the vibration in a hotel building in Texas. The vibration was most prominent in a second floor dining room and on a dance floor at the top of the building. As I recall the building was about ten stories high. The vibration was caused by two synchronous motor driven air conditioning compressors in the basement of the hotel. When the compressor crankshafts operated in unison or near unison the vibration took place. The problem was how to prevent the two compressors from getting locked into synchronous speed with their crankshafts in phase. This was solved by a contact ring on each compressor shaft and interconnected with the synchronous motor switches so the compressors locked into synchronous speed only when the crankshafts were out of phase. This stopped the vibration in the hotel building. The system was patented (#,239,244) April 22, 1941 and was also successfully applied to a department store-office building in Florida. Carl C. Nelson." Very interesting Carl, and we hope the patent is still providing you with nice royalties.

Samuel R. Spiker wrote concerning Carter Swift's death. He writes, "It was only recently that I learned that **Morton Carter Swift**, '26, died in Pompano Beach, Fla., on December 3, 1973 of lung cancer. The news came from his widow to Dike Arnold, '27, and then to me to write an obituary for our fraternity paper. Mort and I started together in the Class of '25 but somehow he slipped back into 1926."

Class President Dave has received the following message. "Dear Mr. Shepard, My husband, **James Boyd**, died January 28 after an illness lasting three years. He was always devoted to his memories of the Institue. Sincerely, Henrietta Hammond Boyd."

For the Class our sincere sympathy to Mrs. Swift and Mrs. Boyd.

Upon returning home a letter from Dave Shepard brought the sad news of the death of one of our most colorful classmates, **Giles E. Hopkins**. "Hoppie" a batchelor had lived at the New York Athletic Club for 30 years and had been associated with the textile industry as technical director of Bigelow Sanford Carpet Co., the United States Asbestos Co., and Director of the U.S. Institute for Textile Research. Even in retirement he became a part-time teacher of textile science at the Fashion Institute of Technology. We have read the Notes of Will Gardiner, Secretary for '25, and he ends, "This is a red-letter month because I do not have to record the passing of some classmate. This may be little consolation but our neighboring classes appear to be having the same actuarial experience. So with our best wishes for the summer months, Cherrio until September.—**George Warren Smith**, Secretary, P.O. Box 506, Pigeon Cove, Mass. 01966

# 27

As I write these notes, at the end of May, we are preparing to go back to Cambridge for the alumni festivities of the June 2 weekend. I'll have a report, and hopefully a little more news about our classmates, in the next issue of the *Review*. This will be a 'leisurely' three-day visit for us; we usually dash up to Boston one day and back the next, with time only for a brief family visit—especially to see my 92-year-old father, who is now physically disabled but so alert mentally he can still outthink most of us.

I have a card from **Ed Damon**, from Hong Kong, where they were on a four-month round-the-world cruise on the M. S. *Mersey Lloyd*. That is really a leisurely trip. Ed said the first three months were delightful, and they were looking forward to the final month. They had already been to South Africa, Persia, India, Sumatra, Malaysia, Singapore and Taiwan, and were to come back through the Panama Canal with stops in Colombia, Venezuela, Vera Cruz and New Orleans before returning to Oklahoma. . . . **Frank Kear** has also been travelling. He writes from Washington, D.C., that he is en route from Sydney, Australia, via Tahiti and San Francisco to the British Isles. . . . **Mark Robbins** is still working on the auto race circuits, and on the side, restoring M.G. TF's. That should keep him young; I leave that sort of activity to my son, who just flew his Cessna out to Indianapolis for the "500," but is beginning to feel too weighted down with other responsibilities to do much car tinkering these days.

A nice, chatty letter from **Howard Page** tells me that since retiring in December, 1970, he has devoted his time to travel and to helping two Near East organizations. He is Chairman of the Board of Trustees of the American University of Beirut and Chairman of the Executive Committee of the Near East Foundation.

He was in Beirut in April and was scheduled to return in June for a Board meeting. In January and February, 1971, he served as a consultant at the oil negotiations in Teheran, and in March of this year he testified before Senator Church's committee. From his vantage point of years spent in the Near East and continued contact with that area, he senses that now is the first time in many years that a settlement of the disputes there could be considered at all possible. But his optimism is a very cautious one; I read his forecast as hopeful, rather than confident.

Again, we express the heartfelt sympathy of the Class to three more members who are gone. **Aram J. Vart** died on March 27. He came to M.I.T. (as Aram Vartaressian) from his native Armenia and became an electrical design engineer. At one time he worked for Wyandotte Chemical. At the time of his death, he was living in Southgate City, Mich.

**Charlie Tedford** passed away on February 27. He had spent most of his business career in the retail business with W. T. Grant-Ben Franklin Stores, for whom he managed operations in 17 eastern states at the time of his retirement. Charlie had always felt close to M.I.T., and in these Notes in January, 1973, he shared many of his reminiscences of our undergraduate days.

**Jim Chamberlain** died at Duxbury, Mass., in January. He had previously lived in Akron, where he was President of U.S. Stoneware. Before joining U.S. Stoneware in 1930, he had worked briefly for Goodyear Tire and Goodyear Zeppelin, and he remained an aviation enthusiast all his life.

I have received a change of address notice from the Alumni Office for **William H. Lempka**. He has moved from Florida, N.Y., to the State of Florida—Lakeland.—**Joseph H. Melhado**, Secretary, 24 Rodney Rd., Scarsdale, N.Y. 10583

# 28

**Jim Donovan** had occasion to correspond with **Dick Hildick** last spring. In his writing, Dick accused Jim of being "as active and cantankerous as ever." Like Jim, Dick is still much occupied with business and is Chairman of the Board for Curtis and Marble Machine Co., in Worcester, Mass. . . . More recently Jim talked with **Cal Caldwell**. Cal started out at M.I.T. in Course X, graduated in Course XV, then went to work for Sears Roebuck along with **Bud Gray**, **Bunney Burnell** and **Joe Gaffney**. Cal is now retired and living in Lombard, Illinois where he is very busy with the Park Department and other activities. He and his wife are looking forward to attending the 50th in 1978. . . . We have learned from **Walter Anderson** that, though retired, he is busier than ever. Andy is active on the Council on Aging and serves as Treasurer for a related group, The Wayfarers. This latter group arranges trips and tours for older people. Recently they completed a 10-day Caribbean cruise on the *Rotterdam*. Last year they put on a trip to Spain and Portugal. Now they are arranging a 22-day trip starting in Holland and progressing to the Austrian Alps. Andy and his wife, Elva, join in some of the tours. . . . On May 15 the

coaching launch *Ralph T. Jope '28* was appropriately christened by **Florence Jope**. The ceremony at the Pierce Boathouse was well attended by M.I.T. notables and various crew members. Representing the Class also were Frannie Donovan and **Walter Smith**. The launch was a gift from Florence to the Institute in memory of Ralph who did much to promote crew activities at M.I.T.

Earlier this year **Ernie Knight** sent Florence a panorama group photograph taken at the '28 Class Outing at Ramsford Island on May 31, 1928. Showing nearly 200 individuals, it is perhaps the earliest group picture of the Class. In an accompanying letter, Ernie wrote: "Some time last fall, when I had a few short breathing spells after summer activities, I ran across the enclosed picture taken at the '28 outing before graduation. Too bad I did not have it for the reunion at Bald Peak—I do not recall that there was one there for display along with pictures of our reunions and allied events. I spent a little time going over the faces to see how many I could recall. I started a chart then called it quits. Perhaps others can add to it." Ernie has donated the picture to be put with other things that can be resurrected for 1978. He has a bottle of beer from the freshman get-together in 1924 and expects to have that there too.

With deep regret we must report the death of **Joseph C. Whitcomb**. A letter from his wife, Helen, informs us that Joe died on April 14, 1974. He had retired in 1967 as President of the Maxim Motor Division of Seagrave Corp., and at the time of his death, was President of the Middleboro (Mass.) Savings Bank. To Helen and her family we extend the heartfelt sympathy of the Class.—**Walter J. Smith**, Secretary, 209 Waverly St., Arlington, Mass. 02174

# 29

**George J. Burke** writes, "I am sort of semi-retired from our family construction firm where I work five to six hours a day. My wife passed away a few years ago while we were on a trip. Travelling is the thing which I enjoy most, so I am planning to go to Japan this May." . . . **Robert S. Riley**, who officially had retired from Engineered Sinterings and Plastics, Inc., but doing consulting work for the same firm, has now completely freed himself from work and he is enjoying life with his second wife Margaret, whom he married in 1967. . . . (Mrs.) **Francis M. Bonnar** writes, "Thank you for my birthday card. My husband, **J. Robert Bonnar**, '29 has passed away, so I am now a widow. Though I feel that I should not be included as a member of class of '29, as I attended classes at the Institute for one year and later attended and graduated from Boston University, I feel honored and pleased to be numbered among you, since both my husband and son are M.I.T. graduates. We have a special pride in our association with M.I.T."

**John Happel** writes, "Thanks for you note. I am glad you are enjoying your winter vacation in Florida. I have been very busy this past year. First, our School of Engineering at N.Y.U. was discontinued after 100 years due to financial problems. I was made a Professor Emeritus and presently, I am a research associate at Columbia University. I have also started a small company to do research and development in the field of catalysis which has been my interest in recent years. We just returned from a trip to Europe. My wife, Dorothy had concerts in London. I visited a research colleague at the Fritz Habes Institute in Berlin. Both of us had a few days of relaxation in Southern Portugal. It does not seem likely that we will attend our 45th Reunion which we tentatively had planned. Best wishes to all classmates." . . . **Louis F. Southerland** is still active as a Senior Partner in an architectural firm of Page Southerland Page with its main office in Austin, Texas; and branches in Corpus Christi and new ones just opened in Houston, Texas and Columbus, Oh. The firm has a staff of 100 engineers and architects and it does mostly medical oriented buildings, and educational and general commercial structures. A new home office building has been just completed with 20,000 square feet floor area.

**George L. Robbins** writes, "I retired in 1969 from the Naval Facilities Engineering Command and moved to Mobile, Ala. I feel honored to be included in the roll of Class of '29 because of my short stay at the Institute. While in the Washington, D.C. area, I was contacted several times by the members of the Alumni Club to participate in their activities, but I considered it too presumptuous to be classed as an alumnus. I am certain that I would not recognize any of my classmates other than those with whom I attended Chauncy Hall." . . . **Laurence L. Waite** writes, "I read the Class Notes with great interest in the *Review*. I was very sad to read about Brig Allen's and Frank Pierson's death. I retired from North American Aviation after 37 years of service. The last ten years were in travel from Hong Kong to Moscow, the long way around. If I never get on another airplane, it will be too soon. In retirement, I putter around TV sets and ham radio. I have fixed all the things that needed repairs around the house, so now I will have to get another house to work on. I drive occasionally for a mortuary outfit—it is the first job I have had where the customer can't talk back. Regards to all classmates." . . . **Michael C. Casserly** writes, "After retiring from United Air Lines as Chief Engineering Test Pilot, I have put aside all forms of useful work, and have confined myself to pursuing the Wiley trout in the waters of the western part of our country." . . . **Arnold S. Wood** spends four months of the year on the west coast of Florida, to keep warm and get out of the snow country and then returns to Marblehead where he has lived all his life. "All of our three children" he continues, "live in Swampscott, which is the next town from where we live. Our granddaughter is graduating from Wellesley College this June. We also have two grandsons who are graduating from University of Maine."—**Karnig S. Dinjian**, Secretary, 6 Plaice Cove, Hampton, N.H. 03842

# 30

We have at hand a delayed report that **Willard Paine** retired as of May 1970. Upon graduating from M.I.T., Willard went to work for Bendix in South Bend, Ind., and by 1943 had become Chief Engineer. In 1943 he went to Owosso, Mich., as General Manager of a new wartime division manufacturing aircraft fuel injection systems. Following World War II, he served as General Manager of The Skinner Purifiers Division in Detroit, and thereafter moved to the Bendix Kansas City division, which manufactured complex equipment for the weapons program of the Atomic Energy Commission. In 1957 he moved to Elyria, Ohio, as Executive Vice President of Bendix-Westinghouse Automotive Airbrake Co. He was elected President of B-W in the following year and in 1969 became Chairman of the Board, from which position he retired. Willard and his wife are now living in La Jolla, Calif. . . . **Greg Smith** is in the news again with an exhibit of his photographs in the Undergraduate Research Opportunities Program conference room at M.I.T. He is described as "a well-known amateur photographer in the Boston area."

**Paul Richardson** retired from his job at E. A. Sargent and Co., in Chicago about five years ago and is now living in Hampton, N.H. Paul reports that he is "still in fairly good shape after five years of retirement" and has two brothers and three sisters living close by. . . . Etta and **John Moriaty** were apparently the only representatives of the Class of 1930 to attend the 26th M.I.T. Fiesta in Mexico in March. . . . As many of you know, **Emmanuel** "Manny" **Birnbaum** retired as President and General Manager of Hart Chemical Ltd., in Guelph, Ontario, several years ago. He is now associated with a group known as Canadian Executive Service Overseas and is presently in Rio de Janeiro as a volunteer business consultant. C.E.S.O. is a nonprofit organization established in 1967 by a group of business leaders with the support of the Canadian government, to assist developing countries by recruiting senior Canadian executives and technical experts to serve abroad as volunteer specialists for a maximum of six months. Rio sounds like a choice assignment, Manny. . . . **James Pickell** retired from his architectural practice in 1964. He and his wife, Mary, are living in South Naples, Fla., and enjoying a relaxed retirement reading, fishing and travelling.

We have a note at hand that **Godfrey Thomson** died on February 10, 1974 in Beulah, Colo. Unfortunately, no details are available. According to my records, as of March 1970 Godfrey was working for Colorado Fuel and Iron Corp., in Pueblo, Colo.

Changes of Address: **Charles G. Habley**, Peace Corps, American Embassy, Kuala Lumpur, Malaysia; **Earl L. Krall**, 39D Haddon Rd., Cranbury, N.J. 08512; **Albert B. Deyarmond**, Route 4, Box

830-71, Sonora, Calif. 95370.—**Gordon K. Lister**, Secretary, 530 Fifth Ave., New York, N.Y. 10036

# 31

A note from **John Swanton** dated April 15, says that Louise and he were taking another trip abroad for six weeks, starting the following Sunday. First they are flying to Egypt for a week, as far as Aswan, then back to Amsterdam where they start camping through Austria, Hungary, Yugoslavia, Bulgaria and Greece. They are also taking the boat trip through the Greek Isles. Sounds like a wonderful trip and hope they have a fine time. . . . **John McNiff** writes, "Retired from Simplex Wire and Cable Co., Power Cable Division at North Berwick, Maine, in January 1972. Since August 1973 I've been Building Inspector of Kennebunk while hoping that the Contractors and Developers Club will complete their promised building code and an accompanying proposal for a paid code enforcement officer. When the town adopts the code and votes to have a paid building-plumbing-electrical inspector, I'll be able to spend some time developing a tree farm in Royalston, Mass., that I've had for 15 years. **John Harrison** is the only classmate I see. He has a hardware store here but lives in Durham, N.H., and plans someday to live here."

While in Tokyo recently, I had dinner with **John Minami** and his wife, both of whom are not only keeping well but are very proud grandparents. John has raised a beard and looks very dignified. . . . A recent article by Jean Caldwell entitled "Chilly Architect Looks Ahead to the Past" tells of **John Parker's** activities as an architect. John spent 10 early years designing buildings at West Point and now specializes in designing houses. . . . Three of our fortunate classmates attended the 26th M.I.T. Fiesta in Mexico. They were Julieta and **Juan Bolanos**, Carmen and **Antonio De La Torre** and Barbara and **Stuart Knapp**.

A recent notice tells of **Jack R. Weprin's** death on February 9, 1974. Our deepest sympathy to his family.—**Edwin S. Worden**, Secretary, 35 Minute Man Hill, Westport, Conn. 06880; **Ben W. Steverman**, Assistant Secretary, 260 Morrison Dr., Pittsburgh, Penn. 15216; **John R. Swanton**, Assistant Secretary, 27 George St., Newton, Mass. 02158

# 32

Colonel **Latimer W. Glowa** (Retired) reports from Columbia, Md., that he has plenty of retirement activity in the Maryland Chapter, Armed Forces Communications and Electronic Association and the National Space Club, Washington, D.C., following up the latest developments in the satellite/terrestrial communications area.

We regret to announce the passing of the following classmates: **Francis E. Elmer**, Springfield, Ohio, July 28, 1972; **Thomas R. Hartigan**, Danbury, Conn., January 20, 1974; **G. Fraser Casey**, Glen Cove, N.Y., February 20, 1974 and **William R. Schuler**, Syracuse, N.Y., May 4, 1974. Our sincere sympathy to their families.—**John W. Flatley**, Secretary, 6652 32nd St. N.W., Washington, D.C. 20015

# 33

Well, "the time has come," the Walrus said, "to talk. . . ", and fellas and gals, we have dang well little to talk about this time. I considered omitting this one altogether, as the prospect of writing a column without news of any kind, of a personal nature, is frightening. We have just one personal note, this from **Carl Swanson**, a continuation of a previous note so that there is nothing new whatever. So, we expand a little on Carl and hope. To remind you, Carl and family have moved from Lon Gyland, Jackson Heights, to Newtown, Conn. Apparently, Carl is of the gregarious type, as right away he has to know who the classmates are within driving distance of the new home. So I did it the easy way; I asked Dick Knight of the Alumni Office for one of his current class rolls, machine made, and gave Carl every classmate west of the big river. He is now quite happy, except that he has to pay me by sending in class news of any and all the boys he turns up. Carl's good wife tripped over something, fell and broke her wrist which put the onus right on Carl, to do many chores. This is, of course, temporary, but annoying, and tough on the little girl. Now I await a great volume of news of the faithful from Carl. . . . Now comes **Dick Morse** again, and as usual, from the press. It appears that Dick has been named to the Technical Advisory Board of the U.S. Department of Commerce. The board is composed of 14 members who endeavor to study and evaluate the technical activities of the department. Golly, this fella could just about make it if he used both hands! Great stuff, Dick, and take it easy.

From Lehigh University we have word, via the press, that **Basil Parker** has retired from teaching at Lehigh after many years there as Professor of Biology. He received his S.B. with us, a master's from Harvard, then took his Ph.D. from M.I.T. Basil served the usual time as head of the biology department at Lehigh, acted as professor for 30 odd years, then spent most of his time in research on the Delaware River Basin, an effort sponsored by the Interstate Commerce Commission, and served as consultant on water pollution for 10 industries and many states. Apparently, we have had among us a very distinguished citizen and classmate. We wish you all the best in your retirement, Basil.

Again the time has come to make a confession. For the first time in 11 years I missed getting Notes published in the *Review!* I prefer not to remember just what issue I did miss, and the extraordinary thing about it was that not one classmate chose to mention it via the mail. This from a group who express appreciation for our usual Notes.

I have some rather belated news from the Alumni Association telling of the passing of **John E. Logan**, E.E. I know that I mentioned this in the Notes that I wrote and never did see in print, and of which I can find no evidence at all. John lived in Boca Raton, Fla., just three miles away from 1079. John retired from the Jersey Central Power and Light, as Executive Vice President, two years ago, I believe. Among many other things, John was credited with initiating the well-known Oyster Creek nuclear generating station; one of the first. Golly, I am sure sorry to lose a good classmate who lived so close in. I speak for our Class in sending to Mrs. Logan our most sincere sympathy. . . . We have three others much more recently reported. **Edward C. Peterson**, C.E. passed away February 5, 1974. I did not know Ed and did not hear from him. **Walter J. Farrell**, M.E., passed away on December 3; I did know Walter as a frosh. **Joseph H. Wetherell**, E.E., passed on October 9, 1973. Now I did know Joe about all the way, and many of you will remember Joe as a great guy. I do not remember many details but Joe was very much in evidence as a student, though he turned out to be a poorer correspondent than I would have hoped. We offer to these widows our sympathy, through me, and as a Class. We do hope that time will heal the pain of such a loss, and to be able to remember these boys as they were; nice guys. I have written to the widows for you fellas. Please note that we have four this time, which is too many. It might behoove us who survive to take it a little easier and behave a little better.

We have the usual changes of address, to wit: **William H. Barkley**, M.G.; **William H. Brothwell**, C.E.; **Bretton Perry**, C.E.; **William E. Rand**, C. These addresses are available for the usual purchase price; just ask for what you need, include your family story, and news of the supporting phases like the job, etc. I wish here, to bring y'all up to date on some of our procedures. About once a month all Secretaries receive a long list of address changes; some are actual changes of address, same town or no. Others might show one of ours now living in the same apartment house, but in a larger apartment; others add only a zip code which has been long in coming. The changes I mention are only actual moves from one location to another. Out of the original total, the changes here are about 10 per cent. We realize that the Alumni Register must have a good reason for the long list, but I have not made inquiry.

I have an added feature this time. With only one personal note this issue, I now ask that the following men make an effort to drop me a line (see address below). Every one here has been heard from in the past. Fellas, we must have news for the *Review*. We all admit that we have the best Class ever to graduate from the Institute, but we are not proving it by enough names heard from. We could write four columns from one source but I sure would prefer writing the same four with 15 names heard from, so, approximately 20 names follow: Fred Aldridge, Jack Andrews, Ed Atkinson, Arra Steve Avakian, Werner Bachli, William Baur, Charlie Bell, Charlie Britton, Ray Brown, Newt Buerger, Joe Carbonell, Charlie Cashman, George Churchill, El-

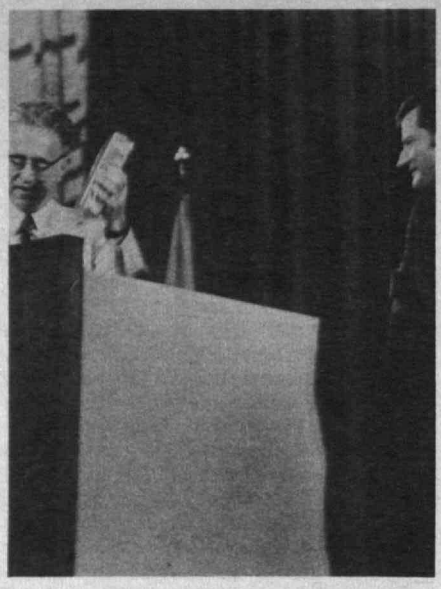
lery Clark, Dayt Clewell, Bill Conant, Rog Congdon, Ralph Cross, Warren Daniels, Bob Dillon, Walt Duncan. I have to get 45 per cent replies from such a list to break even with the overhead, so get on the ball and write me an interim letter for September, which will be written and mailed late July. For the wives and sweethearts of this group who read the *Review*, please get after the spouse and shame him into writing me. Heck, I'd rather hear from the girls anyway. That's it for this time around. Please note the address below and be aware of the fact that we are seven miles from I-95, so don't go driving by so dang fast. Stop and refresh yourselves. Leona joins me in this invitation, wholeheartedly. Sincerely—**Warren J. Henderson**, Secretary, Fort Rock Farm, Rte. 85, Exeter, N.H. 03833

# 34

It's a shame that this deadline comes just ahead of the reunion so you will have to wait until the next issue to find out how things went. However, I do know that 80 members of the Class are expected, all but about five complete with wives. I think this will be the highest turnout we have had for at least the last two reunions. This is being written the weekend before and we've been having rain on and off since Friday. Just hope it's getting it out of its system.

But to business. First I have notices of awards and public service assignments for two members of the Class. **Harold E. Thayer**, Chairman of the Board and Chief Executive Officer of Mallinckrodt Chemical Works was one of four chosen to receive the Missouri Honor Award for Distinguished Service in Engineering from the University of Missouri-Columbia College of Engineering. Harold's selection was based on his 40-year associations with the chemical industry in areas from technical sales to management responsibility. . . . The other item concerns the appointment of **Robert C. Gunness**, President of Standard Oil Co. (Indiana) to an ad hoc committee of the National Academy of Sciences. The committee is to "look broadly at the relationships between science and technology and government with a view to assuring the best use of scientific and technical judgements in the development of public policy and in the planning and management of federal research and development." The committee will be chaired by M.I.T.'s Dr. James Killian. If this group can really be effective in normalizing the wild gyrations that have taken place in the relations between the fields of science and engineering and both the executive and legislative branches of the federal government in recent years, it will certainly have brought forth a miracle.

Coming back to more personal matters, **Frank Milliken** has passed on to me a copy of a letter from **Kenneth L. Dorman**, written in connection with our 40th Reunion Gift Fund. Ken says in part, "As of now I regret that it does not seem possible for Mrs. Dorman and me to attend the reunion. Other responsibilities—among which is care of my 96-



*That "gold brick" in Norman B. Krim's hand stands for nearly $400,000—the amount of the 40th Reunion Gift of the Class of 1934 presented to M.I.T. on Alumni Day. Just visible at the right is William S. Edgerly, '49, President of the Alumni Association.*

year-old father (who still does his own bookkeeping)—preclude our getting away together just now.

"A bit for the class record. I have had two careers since leaving college. One was in textiles and one in organic chemical manufacturing. For the past 15 years I have managed a fine reprographic chemical manufacturing organization which now bills itself as 'second to Kodak.' Note the giant step from number one to number two! We make similar products: color developers, sensitizing agents, photo chemicals, couplers, photoresists, etc. Getting sufficient supplies and trying to keep a harness on labor and quality keeps one busy. No doubt you know all about these aspects of business. However, I don't plan to retire for a while.

"It is seldom that I see your name that I do not remember the courses in Elements of Mining I and II by Professor Locke—most enjoyable elective courses but not living up to expectations that they would be soft courses. A visit to Homestake Gold Mine in Lead, South Dakota, a couple of years ago brought additional M.I.T. memories back as well as a visit to the copper mines in Upper Michigan Peninsula on the drive out.

"Hope your fund raising and the reunion is most successful."

It is really a shame that the Formans are tied up now—they live this side of Providence, less than two hour's drive from Harwichport.

I have belated word of the death of another member of the Class: **Francis E. Cummings**, who died in April, 1973. At that time he was living in the St. Louis area. I'm sorry that our sympathy to Mrs. Cummings must come so late.

There are several notes that have come with contributions to the Alumni Fund. **Tom La Cava** writes, "Bea and I are getting ready to retire. A warmer climate seems to be in order." Rather brief, but they are coming to the reunion so we can find out more. . . . From **Jerry Raphael**, about whom we hear fairly consistently, "Looking forward to a sabbatical leave from University of California next year. Lots of travel and sailing plans, but not too definite. Just completed helping my students build their second ferrocement canoe, a work of art. Hope it is a winner." If you recall these Notes over recent years, you will remember that Jerry, who has received wide recognition for his work on reinforced concrete structures, has for some time been interested in ferrocement boats. There have been a moderate number of cruising yachts and bigger boats built using this technique—but canoes!

**Warren Kunz** comments, "Strongly considering change of pace, this year—i.e. early retirement to cruise more in our small ketch, consult a little, but not too much. Still see **Wilbur Paulsen** occasionally. We still love Mattapoisett on Buzzards Bay—do stop to see us." I'm sorry Warren isn't coming to our 40th—he's even closer than **Ken Dorman**. But I would heartily endorse his feelings about early retirement. . . . **Quentin Smith** evidently has some of the same feelings. He says, "Present position: Administrative Assistant to Works Manager, du Pont Plastics Department Plant, Parkersburg, West Virginia. Looking forward to retirement and travel. All is well with wife and four married children. Sorry to miss reunion this year."

I have a letter from **Frank Moore** explaining why he is going to have to miss the reunion, the first one he hasn't made since the five-year one. But I think I'll save it for next time when I can include it with comments about our big party. These notes will appear in the July/August issue. I hope they find you in the middle of an enjoyable summer.—**Robert M. Franklin**, Secretary, Satucket Rd., Brewster, Mass., 02631; **George G. Bull**, Assistant Secretary, 4961 Allan Rd., Washington, D.C. 20016

# 35

An exciting letter from **Oliver Hoag** starts us off this issue: "I have news for the '35 alumni news—Ollie found a wife in Connecticut. Isabel Roscoe is a sailor, gardener, hiker and cook. We will farm our 7 acres in Vermont; strawberries, blueberries, raspberries, honey, etc. She had three children and now it's six—in Brazil, Hawaii, California, New Mexico, Wyoming and Illinois. It would be quite a trip to visit them all. Since I sold my aperture card business last December, I have been consulting in local manufacturing companies; production, mechanical and electrical problems. Great fun. My Nancy transferred from C.S.U. to Southern Illinois University for a better photography program. Don't know whether she ever did meet Pam. May make Alumni Day, don't know yet." Congratulations, Ollie, and very best wishes to the bride and groom.

**Richard L. Shaw** sent us a note from West Hartford via the Alumni Fund office: "I'm loose! Retired January 1, '74.

No big plans yet, but might even make our Fortieth." . . . **Blake D. Mills, Jr.**, also sent us a note: "I am a Professor of Mechanical Engineering at the University of Washington in Seattle." . . . I saw **Albion Fletcher** at a recent meeting of the Boston M.I.T. Club at which former Ambassador Henry Cabot Lodge was the luncheon speaker. Al lives in Braintree and has been with Stone and Webster for the last eight years. Prior to that he was with Bethlehem Steel. His son, Dick Fletcher, is Secretary for his M.I.T. Class of 1972.

I have belated news of the death of three of our classmates: **Charles E. Slade, Jr.**, of Monroe, La., in March, 1971; **John E. Talbert** of Centerville, Oh., in December, 1973 and **Samuel T. Orton, Jr.**, in Plymouth, Mass., on March 30, 1974. I extend our deepest sympathy to the surviving family members.

Have a fine summer.—**Allan Q. Mowatt**, Secretary, 61 Beaumont Ave., Newtonville, Mass. 02160

# 36

Word has come through that **George Ray** has been appointed Loan Officer of the Mundelein Savings Bank in Illinois where he was born. He had previously been with Boeing, Bell Aerospace, Curtiss Wright and McDonnell-Douglas. That's an interesting switch. . . . **Hamilton Migel** writes that he is retired and living on the water in Charlestown, R.I. In addition to grandchildren and town activities, he keeps busy tending lobster traps, cruising and tennis. . . . Zee and **Larry Kanters** journeyed to Israel this spring to visit a daughter, son-in-law and grandchild.

I am sorry to have to report the death of **Jean Leman** last February 12. He was President of the Candiac Development Corp., and very active in community affairs in the Montreal area. He is survived by his widow, three children and three grandchildren. My memory of Jean stems from freshman physics where he and I were the only students who had studied Greek before we reached M.I.T.

On April 2, **Webster Wilson** died in New York City. He had retired in 1963 as Board Chairman and President of the Hazeltine Corp., and since that time had been a management consultant. In 1968 he was appointed by Mayor Lindsay to the Environmental Protection Administration. He is survived by his wife, two daughters and two grandchildren. To the families of both of these classmates the class sends a sincere expression of sympathy.—**Alice H. Kimball**, Secretary, P. O. Box 31, West Hartland, Conn. 06091

# 39

**Alan Schreiber** sent regrets to **Seymour Sheinkopf** in a fine letter during May saying that he would not be able to attend our reunion. He had to be in Costa Rica on company business. He has his own company, Western Electronic Products, in San Clemente, Calif. But Alan wrote that he is still able to get away for a reasonable bit of travel and also is considerably involved in school advisory committee work and growth-planning advisory commission activities. Following his Costa Rica trip, he had planned to sightsee in Mexico's Copper Canyon, and then to fish in the Gulf of California. Many thanks, Seymour, for forwarding his letter. . . . **Robert M. Toppin** has been named Vice President, Manufacturing, of The Fafnir Bearing Co., a division of Textron, in New Britain, Conn. Bob joined Fafnir in 1962, following a number of years with the Jacobs Manufacturing Co., in West Hartford. Prior to this promotion, he was General Manufacturing Manager at Fafnir. . . . **Ben W. Badenoch** wrote that he is back on the west coast as President of the Tennescal Division of Airco, Inc. His division makes vacuum equipment using electron beam technology for depositing thin films. He is once more enjoying soaring as his major hobby, as he did in undergraduate days.

Dr. **William R. Hawthorne** was appointed by the Executive Committee of the M.I.T. Corporation to serve as Visiting Professor in the School of Engineering for six months beginning January 1, 1974.—**Oswald Stewart**, Secretary, 3395 Green Meadow Circle, Bethlehem, Pa. 18017

# 40

News this month is brief. **Tom Jones** has resigned as President of the University of South Carolina effective June 30, 1974. . . . From **Clement Burnap** comes the news that 'the Corporation' fooled him again. "I left my consulting company to build up international operation for a container crane builder. First assignment—to organize London operation. After 18 months I was out. Starting business again of taking U.S. products overseas. Need people with challenges!" My apologies to Clement for leaving out part of his letter but his hieroglyphics are even worse, if possible, than mine. . . . **John Beattie** states, "I am managing partner of an enterprise called Beattie Development Company. It is owned jointly by me and by Itek Corp., of Lexington, Mass. We have just developed a new process for manufacturing plastic ophthalmic lenses which Itek will manufacture and market." . . . The final note is from **Bonner Hoffmann**. "Am now Vice President of Finance and Secretary of Gender Paeschke and Frey Co., in Milwaukee. I am also on the Board of Directors. Am living in Racine County, Wisc. Had a pleasant visit with Mr. and Mrs. **Scott Brodie** at their home in Gulf Breeze, Fla., and at their 'depot' restaurant constructed of railroad cars." . . . At the 26th M.I.T. Fiesta in Mexico in April **George Kosco** and his wife, Bernadette, were present.

It is not too early to start thinking about our 35th Reunion next June and again, remember to write to Al.—**Al Guttag**, Cushman, Darby and Cushman, 1801 K Street N.W., Washington, D.C. 20006

# 47

Some beautiful spring weather is allowing us to expend our efforts on the golf course. To date it is all hard work but maybe next month balls will bounce off trees onto the fairway and putts will drop—one can always hope.

Had an enjoyable lunch with **Walt Ericsson** last month. He is still Vice President of A. G. McKee, a major oil, chemical and steel plant construction firm. The shortages in the fields that they serve means that they are obviously busy at present and should remain so for at least the next few years. This activity also leaves him in need of talented people. On the homefront the major occurrence in the Ericsson household was the marriage of daughter, Nancy, in February. She and her husband are staying here in Ohio.

It was very pleasant to receive a letter from **Don Dewitt** which reads as follows: "As I'm sure many other classmates do, I read the Class Notes column with interest, and vow that someday I will take pen in hand. Having recently been elected Chairman of the Planning Commission, City of Beverly Hills, I decided the time was finally appropriate.

"Having lived in Beverly Hills for 20 years, a few years ago I decided to stop criticizing and become involved in the community in which we live. I was a member of the Traffic and Parking Commission for two years, and have for the past two years been a member of the Planning Commission, and am now in the enviable position of listening to others complain. Otherwise, Marian and I have four children, a daughter of 23, married and presently living near Brussels, Belgium, one son, a Junior at Harvard, one in high school and a seven-year-old in the first grade.

"I own two tool supply businesses, one in Los Angeles and one in San Francisco, supplying cutting tools to the metal working industry.

"Try to keep up with golf about once a week and tennis rather occasionally these days. I hope you and your family are well. Maybe our paths will cross one of these days. Kindest regards. Don Dewitt"

From the clipping services we see that **Harold Brodsky** has been promoted by Fafnir Bearing Co., Division of Textron, to Vice President of Operations. In his new capacity he will have responsibility for manufacturing, sales and product planning. Harold has been with Fafnir since 1947 and will continue to reside in New Britain, Conn., with his wife and two children. . . . **John Truxal**, Dean of Engineering of the State University of N.Y. at Stony Brook, received the Education Medal from I.E.E.E.

Professor **Samuel Mason** of the electrical engineering department at the Institute recently died. He received his master's degree in 1947.

**Bob Creek** has been elected to his fifth term as President of the local school board. He now has two children at Knox College with one graduating now. . . . **Jack Greene** is Deputy Assistant Director for Research of the Defense Civil Preparedness Agency.

As I sign off, why not follow Don Dewitt and take a pen in hand and drop us a note.—**Dick O'Donnell**, Secretary, 28516 Lincoln, Bay Village, Ohio 44140

# 48

**Peter Saint Germain** writes that he is associated with Morgan Stanley and Co., and has been with them for the last 18 years. . . . **Ralph Segel** has moved to Wilmette, Ill., so as to take advantage of the North Shore and to be near Northwestern, where he is Professor of Physics. Ralph and his family are all looking forward to a summer of beaching and sailing. Ralph still spends a lot of time at Argonne National Lab where he is Senior Physicist specializing in nuclear research.

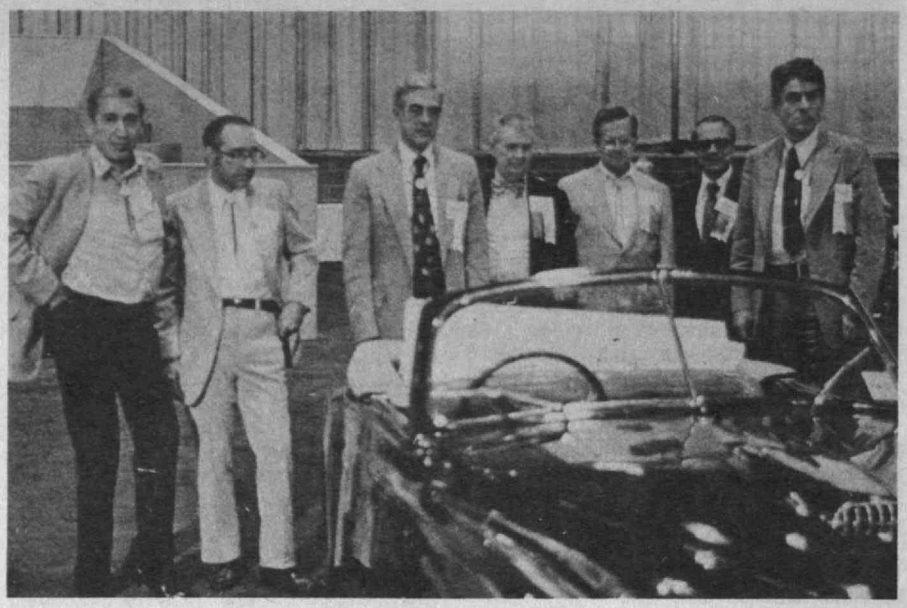
**James Guida** has retired to Arlington, Vt. James is very busy repairing rock walls, hiking and skiing. . . . **Dan Fink** has been elected to the National Academy of Engineering in recognition of his "contributions to aeronautics and space in government and in private industry."

The National Academy of Engineering is a private organization established in 1964 to share in the responsibility of the National Academy of Science. Dan now is one of 507 engineers in the Academy.

Dan wrote an editorial for A.I.A.A. discussing the ways that a technical education gives the student effective methods for analyzing and resolving complex problems in many disciplines. Dan wrote that the nation is becoming aware that in producing new things, high technology also produces new ways of thinking about things. Dan writes, "Although encouraging on the whole, our experience has also reminded us that these methods are difficult to impress on a society which has traditionally been more responsive to political and economic expedients than to rational analysis."

**Bob Day** wrote to me about his assignment as Manager of the recently established Northeast Regional Office in Philadelphia of Black, Crow and Eidsness, Inc. Bob's firm has been providing complete environmental engineering services to its municipal and industrial clients through its officers in the East and South, for close to a quarter century. The firm is presently developing a five-year master plan for the automation of the city of Philadelphia's water operation's division.

**Charles M. Wiswell** died in April of this year. Charles was living in Cumberland Mills, Maine at the time of his death. . . . **Graham Sterling** has been named Director of Planning and Control for Analog Devices, Inc. Graham will be responsible for developing and implementing operational planning and controlling policies for the corporation. Analog Devices had sales of $22 million of electronic components used in measurement and control instrumentation. Mr. Ray Strata, President and Graham's boss said, "If we want to become a $100 million company, the best way is to start thinking and acting like one." Graham served Texas Instruments for 17 years. He introduced a Business Operating Model concept which has since been elaborated and used throughout Texas Instruments. Graham is Treasurer of our Class. We wish you the best of luck in your new position.—**S. Martin Billett**, Secretary, 16 Greenwood Ave., Barrington, R.I. 02806



*That's the Class of 1949 Reunion Gift Committee standing around the 1949 Ferrari at the Alumni Day luncheon; they were there to escort their Chairman, Leonard F. Newton, to the platform with his replica of an American Express card and his check for $500,000 to be presented to President Jerome B. Wiesner (left photo). The bottom picture is designed to whet your appetite for the full account of the June 1-4 reunion which will appear in this space in October/November.*

# 49

Our 25th Reunion has come and gone with 100 classmates and their families (mais ou menos) in attendance, and $501,002 in contributions towards the class gift—our visiting professorship. **Len Newton**, his hardworking committee, and all classmates deserve congratulations. As do **Stan Margolin**, **Paul Weamer**, and all the reunion committee for the smooth-running flow of activities (booze and food, in particular—our mascot isn't the "drunken beaver" for nothing).

For a blow-by-blow account of the festivities, see our forthcoming columns. Who did what to whom (particularly the McCormick House maids, in collusion with some hitherto unsuspected devilish wives, in redecorating the Ligors' (the Quicker's?) room on Monday). All this, and much more, will be revealed at an appropriate time.

Class officers for the forthcoming five years: **Paul Weamer**, President; **Harry Lambe**, Vice President and Treasurer; and **Frank Hulswit**, Secretary. Plus authorization for the class officers to appoint others to temporary assignments.

So, for better or worse, we are stuck with each other for another five years of Class Notes. I'm looking forward to it. I hope you are too. And keep those technology-fund-news notes and letters coming in folks. Best wishes to all.—**Frank T. Hulswit**, Secretary, c/o Arthur D. Little, Acorn Park, Cambridge, Mass. 02140

# 50

**Fred H. Bergmann** is administering a Grant's Program in Genetics for the National Institute of General Medical Sciences (part of N.I.H.). He has been married for nine years and has two children, Sarah (7) and David (5). Fred says he is enjoying life more in his forties than in his teens, twenties, or thirties. . . . **John R. Bedell** has recently moved to New Jersey. He is presently employed as Project Manager for Allied Chemical Corporation Materials Research Center. At other times, he is developing a tree farm and pulling trout out of his pond.

We regret to announce the sudden death of **William F. Helmich, Jr.**, on November 23, 1973.

Dr. **John F. McCarthy, Jr.**, M.I.T. Professor of Aeronautics and Astronautics since 1971 and a widely recognized expert in systems engineering and vehicle design, has been named Director of M.I.T.'s Center for Space Research. Since 1971, he has chaired the Aeronautical Systems Division Advisory Group of the Air Force Scientific Advisory Board. He recently was awarded the Meritorious Civilian Service Award by the Air Force Systems Command for his work on the C-5A transport airplane. Dr. McCarthy is the author of numerous technical papers and contributor to four textbooks.

The **Uncas A. Whitaker** Professorship in Biomedical Engineering has been established at M.I.T. and Dr. **Robert W. Mann**, M.I.T. Professor of Engineering and a widely known pioneer in this field, has been appointed the first holder of the chair for a five-year period. Since about 1960, Professor Mann has directed his activities towards biomedical engineering, in particular to the development and application of rehabilitation technology.

He has become internationally known for work in sensory aids for the blind, including computer-based rapid Braille production, work in navigation-assistance devices for the blind, and for work on advanced prostheses, for example, hip joints and artificial limbs. He was a co-developer of the so-called Boston Arm which uses faint bioelectrical signals from residual muscle tissue to operate a forearm prosthesis. Professor Mann belongs to numerous professional societies and has been the recipient of several important awards. He is married to the former Margaret Florencourt (M.I.T. '46, Electrical Engineering) and they make their home in Lexington, Mass.

Please remember that in one year's time our Class will celebrate its 25th year since graduation. I'd like to remind one and all of the 25th Annual Reunion in 1975. Seversl important changes as to date and timing of Alumni Day are contemplated for 1975. Your reunion committee will keep you fully informed in the near future. Please also keep in mind the Reunion Gift Program for the Class of '50. **Myles Spector** has recently assumed the chairmanship of this committee and will be in contact with all in the near future.—**John T. McKenna, Jr.**, Secretary, 2 Francis Kelley Rd., Bedford, Mass. 01730

# 53

Dear classmates and fellow non-letter writers: *Please* do help all of us out and take the time to jot down at least a few lines about your life and times (or about those of classmates you happen to see). . . . One classmate is doing really interesting (and perhaps remunerative) things. **Henry Kloss**, who "guides Advent Corporation", an outfit started in 1967, is now marketing a unit called Advent VideoBeam—an electronic device which successfully and dramatically throws a full-color, six-foot by four-foot television image on a special screen set up eight feet away, according to a *Hartford Times* report. Sounds damn exciting to me (other than the price tag at the moment). Good luck! . . . **Rudy Kalman** received the Medal of Honor from the I.E.E.E. in New York; the Medal, "recognizing a clearly exceptional addition to the science and technology of concern to the Institute, consists of a Gold Medal, a certificate, and $5,000." Rudy is currently Graduate Research Professor at the University of Florida (Gainesville), and is editor of three professional journals.

Recently at the Solid State Circuits Conference of the Institute of Electrical and Electronics Engineers, **Jerome Tiemann** (and two colleagues) described a new semi-conductor device for analog signal processing, with more than 100 times the computational power and speed of conventional components. The work was carried out by Tiemann and others at the G.E. Research and Development Center, Schenectady, N.Y. . . . **Peter Demos** serves as Director of the Bates Linear Accelerator (L.I.N.A.C.) project—under construction by M.I.T.'s Laboratory for Nuclear Science for the past seven years—and announced in January that it has just achieved the full 400 million electron volts energy level. (He is a Professor of Physics at M.I.T.) Also, the spectrometer which is utilized with this accelerator was designed by **William Bertozzi**, who like Demos is a Professor of Physics at M.I.T. . . . Last fall **John Ehrenfeld** co-authored a paper which dealt with particulate emissions reductions; it was delivered at the third Urban Transportation Technology Conference in Boston. . . . That is *all* the news from you krazy kats; please do better next month. Put differently, "I aim to please; I hope you will do likewise."—**Martin Wohl**, Secretary, 1420 Centre Ave. (Apt. 1706), Pittsburgh, Pa. 15219

# 54

At this writing, the hastily reconfigured (from Bermuda to Cambridge) 20th Reunion is a week away. Hope to pick up some news there.

**John Rufo**, President of Boston Power Associates, has proposed a system which consumes waste materials to generate power for Boston's subways and trolley cars. Now if we could extend this for home use, the contents of my attic and cellar could. . . . **Andre Sampou** has been appointed Vice President for Manufacturing at Instron Corp., where he is responsible for the firm's domestic production activities. . . . **Jim Hazard**, besides developing special machinery at Scott Paper, is helping to restore a 19th century Delaware Bay oyster dragger with the Heritage Ship Guild of the Port of Philadelphia. He is also "helping raise 5 little darlings", and actively participating with an amateur theatrical group. . . . Pat and **Coley Bresee** swung east recently. This pair of criminal attorneys is really into it. Pat is into competitive swimming—and in a big way. She is at the master's level and recently competed in Washington, D.C. She entered in five events, won them all, and set five national records! Coley is into competitive tennis. Tennis-playing **Dean Jacoby** avoided a recent confrontation and quickly taught Coley to play squash. A result of eight to love in favor of Dean has only quickened Coley's interest in getting Dean on the tennis court.

**Tom Bastis** is reported living in the Hawaiian Islands. . . . **Al Ward** is house-hunting on the west coast. . . . **Paul Gray** suffered a minor eye injury on the squash court.—**Daves Howes**, Box 66, Carlisle, Mass. 01741; **Chuck Masison**, 76 Spellman Rd., Westwood, Mass. 02190

# 55

With the hot and sultry days of summer upon you, I hope you are reflecting on vacations and trips, and planning to come to your Twentieth Reunion next year. A small band of classmates of yours met at M.I.T. during Alumni Days this year and plotted amidst much conviviality.

For the past two years **Francis J. Bonner** has had an academic appointment in the Department of Industrial and Engineering Chemistry of the Federal Institute of Technology in Zurich, Switzerland. He would appreciate knowing of any M.I.T.'ers in the Zurich area. . . . While serving as Natick Regional Chairman for the Alumni Fund, **Phil Untersee** has met several members of the Class—among them **Stan Becker**, who is a minister of the Church of Christ, and **Ed Ehrlich**. Phil is administering new Arthur D. Little service programs in health care, data processing and energy. . . . **Charles C. Ladd** attended geotechnical engineering conferences in Istanbul and Moscow last summer. . . . Another world traveler is **Frank Leitz**, who delivered three papers at the Fourth International Symposium on Fresh Water from the Sea, held in Heidelberg. From there he went to Hebrew University in Jerusalem, where he conducted a seminar on the electrodialysis method of desalination.

**Russell M. Collins, Jr.**, has been appointed Vice President of J. C. Penney Insurance Co. He was the Senior Vice President at Western Life Insurance Co., and St. Paul Insurance Co., and earlier had been Vice President at Minnesota Mutual Life. He is a Fellow of the Society of Actuaries, and is active in a number of insurance and actuarial associations. Russell and his wife, Karla, have three children. They will be moving to Greenwich, Conn., after many years in St. Paul. . . . In January, **Alfred E. Wechsler** was

named a Vice President of Arthur D. Little, Inc. He heads the Environmental and Biomedical Systems Unit of the Engineering Sciences Section. He has worked in several technical areas at A.D.L., including environmental studies, biomedical engineering, and Apollo lunar science experiments. He is an active member of the A.I.Ch.E., A.I.A.A., S.A.E., and A.S.T.M.—**Allan C. Schell**, Secretary, 19 Wedgemere Ave., Winchester, Mass. 01890

# 58

A veritable flood of news has arrived for our last issue of the season. (Anything greater than a trickle, mind you, looks like a flood to your typical Class Secretary). **Jim Braman** is now Chief of the Construction Division for all U.S. Air Force construction projects in Europe. Jim says that "after two years of running the engineering division I was switched to construction so I could live with the design deficiencies and omissions we had created previously. A most interesting task!" . . . **Robert Holz** has joined the entrepreneurial ranks by starting a software development and computer service bureau. The firm is named Xentaur Computing and located in Bellingham, Wash. . . . At Georgia Institute of Technology, **Steve Devoto** has become an Associate Professor in the School of Mechanical Engineering.

Another rare review for the 15th Reunion—this one from Barbara and **Mark D'Andrea**: "We really enjoyed the time at Edgartown last year and thought it was perfect! We keep really busy with our five children at home in Belmont and Mark is heavily involved at the General Electric aircraft engine plant in Everett as Manager, Material Joining." . . . **Charles King** informs us that he is "Regional Geophysicist for Union Oil of California in Houston, Texas. Our children are all in Little League and girls softball (they are still separate here) so our spring is filled with games". . . . **Walter Braun** has received a Ph.D. in theoretical physics from American University. He and Linda have a son, Walter Lee, now nearly 4. . . . While on the population subject, we received an announcement from **Mike Kenyon** that their first son, Colby Michael, was born in June '72. . . . Also from Phyllis and **Merle Persky** an announcement that their third son, Mark, arrived last fall. . . . **Sander Weinreb** has been at the National Radio Astronomy Observatory in Charlottesville, Va., for the past 7 years, where he is Head of the Electronics Division. He and Marjie have two children ages 5 and 10. . . . **Shmouel Winograd** has been made a Fellow of the I.E.E.E. for his analysis of the time bounds required for computation of certain mathematical functions.

After five years as a venture capitalist with A.R. and D., **Dan Holland** has left to rejoin the First National Bank of Chicago. However, this time the locale is Boston where the Bank will be opening an office. . . . Another note from **Toby Carlson** telling us that his bags are packed again and he's leaving Miami and the federal government to begin teaching meteorology at Penn State. During the summer he will be conducting part of a solar radiation/aerosol measurement program in the Cape Verde Islands as part of the Global Atmospheric Research Project. . . . That's all folks! See you in the fall—**Michael E. Brose**, Secretary, 30 Dartmouth St., Boston, Mass. 02116

# 59

The 15th Reunion of the Class of 1959 has passed into history and I start the first of forty columns to be prepared over the next five years. Before highlighting some attendees at the Sheraton Regal in Hyannis, many thanks and congratulations to **Lloyd Howells**, our Reunion Chairman for a job well done. During the banquet on Saturday evening, our new class officers were elected. Some new and some old faces with **Chuck Staples**, President, **Bob McAuliffe**, Vice President, **Ed Safran**, Class Agent, **Dick Sampson**, Treasurer and this column's former writer, **Art Collias**, Reunion Chairman.

My activities as Secretary will be eased with the support of our new Assistant Secretaries and Regional Vice Presidents: **Phil Richardson**, New York, **John Amrein**, Chicago, **Bob Muh**, Los Angeles and **Adul Pinsuvana**, Bangkok. Our objective with this column will be to maintain a steady flow of news on as many classmates as possible. We need your support to accomplish this. So let us hear from you.

Among the attendees in Hyannis were the **John Linderman's** of Hartford and the **Paul Silvermans** of St. Louis. John is practicing law as a patent attorney and Paul is the Director of Marketing Administration for the Angelica Uniform Co. The presentation of prizes was made by **Jerry Welch** who worked long hours assisting Lloyd in reunion planning. Jerry presented the perennial golf award to **Bob Rosenfeld** who led a rain-soaked, mud-splattered threesome with **Jack Fischer** and **Larry Bishoff**. The tennis buffs overcame the weather by playing on indoor courts and the long trip from Bangkok did not hurt **Adul Pinsuvana's** game as he walked off with the tennis honors and obviously the award for having traveled the farthest.

Switching to news received from the backs of envelopes, **Chuck Rowe** is back in Milwaukee as Manager of Quality Assurance at Grede Foundries and **Joe Zimmerman** has recently been appointed Vice President and Group Manager of Texas Instruments. Joe recently led a successful Alumni Fund telethon in the Dallas area as did our new Regional Vice President in Chicago, John Amrein. . . . On the academic front, **Dave Eldridge** just received his doctorate in physics from Ohio University and his wife, Mary Sue, her doctorate in guidance and counseling. Dave has also been appointed assistant professor of Physical Science at Shepherd College in Shepherdstown, West Virginia, effective this fall. . . . **Jerry Stephenson** notes, "the lure of the West and the Physics at Los Alamos was too much for Barbera, Tommy and me. I've resigned my position at the University of Maryland and will be taking up residence in Los Alamos in June." . . . **James Rogers** received his master's degree in engineering from U.C.L.A. . . . From the aerospace field, **Kent McDonald** notes that he is still in aerospace electronics at Hughes Aircraft and **Bob Polutchko** sends his greetings from "mile high country" where he has been working for five years on the Viking mission to Mars. The altitude may have gotten to Bob as he anticipates the Denver Broncos to win the Super Bowl.

Some change in activities as **Bob Wagner** indicates that he is quitting his job as an instrument engineer-designer and returning to New England from lovely (but hot) central Texas. It is difficult to say what Bob will be doing for he is looking for "used apple carts". . . . We also received a long letter from **George Elbaum** who is probably remembered as **George** or **Jerry Whiteman** during his years at Tech. George commented that he had "borrowed" that name on his arrival from Europe in 1950 and had it changed to his correct surname in 1962. After alternating between M.I.T. (two master's and a doctorate) and industry activities at T.R.W. Systems and Planning Research, George took a four-month sabbatical of skiing in Utah to review his career and now travels extensively between Los Angeles, New York and Moscow as a Vice President of Intertorg, a firm which provides marketing services and representation for U.S. companies in the U.S.S.R. George would be happy to hear from any fellow alumni interested in the Soviet market.

To close on a literary note, **Alan Barr** who received his doctorate from the University of Rochester and is currently an Associate Professor of English at Indiana University Northwest, recently published his book, *Victorian Stage Pulpiteer: Bernard Shaw's Crusade* through the University of Georgia Press. . . . Similarly, **Meyer Kutz** was interviewed on the Today Show on the publication of his book, *Rockefeller Power* by Simon and Schuster.

Future columns will include additional items gleaned from the reunion as well as a summary of the questionnaire which was returned by more than 200 members of the class. In the interim, drop a short note to **Phil Richardson** at 180 Riverside Dr., New York, N.Y. 10024, **John Amrein** at 770 Greenwood Ave., Glencoe, Il. 60022, **Bob Muh** at 907 Chantilly Rd., Los Angeles, Ca, 90024, **Adul Pinsuvana** at 49 Seri Rd., Seri Village, Hua Mark, Bangkok, Thailand or myself and let us know what is happening. A happy and sunny summer to all!—**Alan Bufferd**, Secretary, 8 Whitney Rd., Newtonville, Ma. 02160

# 60

We have a letter from classmate, **James H. Middlekauf**, with some recent history, "Although I am currently located in Wyckoff, N.J., I managed to visit Boston recently and see 26.2 miles of it the hard way, by participating in the Boston Marathon. While it was not my


*James H. Middlekauf, '60, in the Boston Marathon.*

day for speed, I did manage to complete the course. My time was an unofficial three hours and 43 minutes, well in excess of my best time for a marathon of three hours and 22 minutes.

"I certainly do not consider myself a top contender, because this year, for example, the best time was a super human two hours and 13 minutes. Rather, I ran in it because a friend of mine suggested that it might be interesting to run at least once in a Boston Marathon for the experience. The challenge was made almost two years ago, and between physical setbacks and the difficulties in qualifying for the event, it wasn't until this year that I could participate. My friend gave up four months after the idea was suggested during our first marathon attempt.

"There is no question that participating in the Marathon is a unique experience. This year, 1722 men and women qualified and entered the race. The majority are like myself and entered for the self-satisfaction, enjoyment and experience. The only other participant that I recognized during the entire event was **Jack O'Rourke**, a fellow '60 graduate. With so many starters, it wasn't until three minutes after the gun that I was able to move. For several miles after the start the crowding was analogous to being on New York's Fifth Avenue at Christmas time. The crowding gradually dissipated as the miles clicked by and the runners were able to move at a comfortable pace.

"The people in Boston are delightful and take an unusual interest in this event. I can see now that this is probably what attracts so many runners from all over the U.S. and the world.

"As for the course itself, it has earned its reputation as a difficult one. There are many hills, and since it is run at the warmest time of the day, the heat has its effect too. I was vowing to myself that I would never run in another marathon, never mind a Boston Marathon. Of course, within hours after the event I was planning my strategy for next year's marathon—how to qualify (since I din't complete the course within the required three hours and 30 minutes), and how to improve my time."—Mrs. **Linda G. Sprague**, 25 Sherman St., Cambridge, Mass. 02138

# 62

**Richard Sutton** is moving to Wichita Falls, Tex., to enter private practice in diagnostic radiology and nuclear medicine. He will be at the Wichita General Hospital starting early July, 1974. . . . **Gerald Fleischli** has been almost four years in Omaha, Neb., with the University of Nebraska Medical Center in family practice and health care studies. He and his wife have three boys, ages 4, 5 and 6, and they all love it. Between work, family and founding H.I.T.S., Inc., (Health Information Technology Services) he informs us that things are busy. . . . **Jeremy E. Alperin** finished his residency program in ear, nose and throat in June, 1973. He is now with the University Hospitals of Cleveland as the Assistant Director of the Division of Otolarynology at the Cleveland Metropolitan General Hospital. . . . **James E. Engeler, Jr.**, informs us that his occupation is physician, hematologist, oncologist and a Commander in the U.S. Navy. . . . **Michael J. Callahan** has been promoted to Staff Director of Semiconductor Research and Development Laboratories for Motorola Semiconductor Products Division. . . . **Louis H. Blair** is Mayor of Falls Church, Va., and also is an accomplished juggler and, on top of that, he does his juggling on a unicycle. His secret desire is to ride away from City Hall on his last day of office on a unicycle, juggling as he goes. He may succeed and has until July 1, 1974 to work on his ambition.—**Gerald L. Katell**, Secretary, 122 N. Maple Dr., Beverly Hills, Calif.

# 63

May 1974. As a Class Secretary I often have correspondence directed to me from members of other classes. One such letter was from George Warren Smith, Secretary of the Class of 1926. George was trying to locate alumni who are yachting enthusiasts. I could only recall two sailors from our Class—**Ken Klare**, who was captain of the sailing team, and **Dick Olson**, also a member of the sailing team. Of course I remember spending many a spring afternoon cruising up and down the Boston bank of the Charles. And I know many of you were out there as well, taking in the sun and the unique Charles River spray. Any of you who might want to do something to make some improvements at the M.I.T. sailing pavilion should contact George Warren Smith at P.O. Box 506, Pigeon Cove, Mass. 01960.

Two pieces of news this month from **Pete Van Aken**. One was on the letterhead of Van Aken Associates of Winchester, Mass., and reported that effective March 1, 1974, Christina Van Aken has joined the firm (which had consisted of just Pete and Carol.) Christina has assumed responsibility for scheduling the activities of the other members of the firm, and will specialize in problems associated with liquid diets and waste disposal. Ms. Van Aken was born in Boston, and the firm expects that she will grow in stature beyond her initial twenty inches and six pounds, ten ounces. The second news item was a clipping showing a picture of a bearded Peter T. Van Aken, and reporting that Pete has been named Assistant to the President of Brandeis University and Director of Brandeis' Analytical Services Division.

Two other classmates report new additions to their families in recent months. **Ron Walter** became the father of a daughter, Amy Lauren, born January 24. Adding to the excitement of becoming a father for the first time, Ron was just named Deputy Assistant Director of the Budget, responsible for New York City's Health and Welfare budget. After 13 years in Cambridge, Ron finally cut the cord and is now living on New York's upper west side. . . . **Mal Beaverstock** is now the father of three sons. Brian, the youngest, arrived early this year. Mal moved to Baton Rouge in late 1971 to work in engineering development for Uniroyal Chemical. He was recently named group leader of the Louisiana Engineering Development section.

Two more classmates are getting, or have just gotten, their Ph.D.'s this spring. **Don Day** is finishing his work at American University in Washington, D. C., and is teaching at Montgomery Community College. While at American University he had an N.S.F. Science Teaching Faculty Fellowship. Don is still a bachelor. **Dale Miller** is finishing his electrical engineering program at University of California, Berkeley. Dale's work concerns ultra-high vacuum scanning electron microscopy and Auger electron spectroscopy. He is doing part-time consulting in scanning electron microscopy for Fairchild Semiconductor in Mountain View, Calif. Dale and wife, Kari, have two little "Vikings", Sven and Hans, who are now 6 and 3. Back in 1970 the Millers visited Oslo and Dale and Sven learned Norwegian.

Things seem to be coming in two's this month. Two classmates have recently gotten new academic positions. **Dennis Buss** has spent the past six months as Visiting Associate Professor in the electrical engineering department at M.I.T. Dennis is presently with Texas Instruments. . . . **Elliot Bird** did his graduate work at Adelphi University and went from there to the mathematics department at C. W. Post College on Long Island. He has just been promoted to Associate Professor and granted tenure. The Bulletin of the American Mathematical Society published a paper by Elliot in September of 1973. Elliot, wife Toby, and son Eric, 2, recently moved into an old colonial house on the north shore of Long Island, in Roslyn, N. Y.

Two promotions: **Calvin Yee** writes that he has been promoted to Manager, Point of Sale Systems, at Supermarkets General Co. His responsibilities include evaluation and installation of electronic cash registers and universal product code scanner systems. Previously (1972), Calvin was with Drake, Sheehan, a management consulting firm in Manhattan. When Calvin made the switch to Supermarkets General he moved out to New Jersey. He, wife Emma, daughter Wendy, 4, and son Eddie, two and a half, are enjoying suburban living. A

February news clip from the *Hartford* (Conn.) *Times*, reveals that **Maurice Andrien**, Vice President of Kaman Corp., has been appointed group head of Kaman's music companies. . . . **Mike Feézor**'s note simply asked, "Where is Steve (Zack) Williams?" I don't know—he is not listed as a member of our Class. Maybe someone else can help.

Don't give up the ship department: A note from **Ray Soifer** crossed in the mail with my last column. Your old letter finally made it into print, but thanks for the letter anyway. . . . Finally, **Phil Graham** wrote: "Three cheers for the gung-ho approach you've brought to the '63 Class Notes. It's very refreshing these days to turn there and see something other than an empty gap between the '62 and '64 columns. For what it's worth, I plan to write you a letter soon. All my notes from the past two years seem to have been round-filed."

No, they haven't been round-filed, and in fact, here they are. In May 1972 you wrote that you completed the requirements for a June, 1972 Ph.D. in Aeronautical Engineering from R.P.I. At that time you were planning a move to Fort Worth, Texas to set up your own company. In April 1973 you wrote that you took charge of your family's company after your mother passed away in late 1972. The company, of which you are President, is Serv-O-Link Corp. So you see, Phil, I know all about your recent history. But don't let that discourage you from writing me a letter anyway.

Have a pleasant summer.—**Mike Bertin**, Secretary, 18022 Gillman St., Irvine, Calif. 92664

## 64

Our Class Hero this month is **Russell Norris**, who wrote to say that he left the world of electrical engineering in 1965 to enter the world of divinity. He completed his doctorate in theological ethics at the University of Strasbourg in 1972, and is now the pastor of three small churches in central Pennsylvania. Russell was married last month to the former Mrs. Dixie Battistella of Mt. Union, Pa. It's nice to know that we now have someone official to pray for all the sinners of '64!

I have received a notice from the Alumni Records that **Robert Oaklund** of our Class passed away on March 9 of this year.

The remaining news is very sparce this month. **Richard Kline** is working for Deering-Milliken in Spartanburg, S. C. This January he had a second son, Charles. . . . **Robert Park** has been active in Science for the People, an organization dedicated to advancing the political awareness of technical workers, and revealing the politics of science and technology. The organization is based in Jamaica Plain, Mass. . . . **Robert Weinberg** is a researcher in M.I.T.'s Center for Cancer Research, and is an assistant professor in the biology department. He is one of five cancer research scholars in Massachusetts who received awards from the American Cancer Society this year. . . . **Len Theran** and his wife, Susan, were visiting her parents in Memphis this April, and got together with Yours Truly and wife, Betsy, for a delightful evening on the town. Len is a product manager with Acurex Corp., in Los Altos, Calif. . . . Speaking of Yours Truly, I have decided that 10 years is a long enough hitch as Class Secretary, and that it is time for new blood to pound the keys each month. This will therefore be my last column, and our new Secretary selected at our 10th Reunion will take over henceforth. I have greatly enjoyed the post and the correspondence, and look forward to becoming a reader of and contributor toward future columns. **Ron Gilman**, 6560 Black Thorne Cove, Memphis, Tenn. 38138

## 65

Well, I've been pretty bad about making the deadlines the past few months—but this column may make up for it a little. You folks have to write more though. At a meeting on computer security in Washington last week (mid-May), I saw **Art Bushkin** for the first time in about five years. Art is working part-time for System Development Corporation on computer security. He and wife Kathy are also co-editors of *The Democratic Focus*, a new political newsletter. The Bushkins have bought a home in the Maryland suburbs of Washington. . . . **Chico Gholz** is also in the Washington area and received an LL.M. from George Washington University in patent and trade regulation last June (1973). His thesis was published in the *Journal of the Patent Office Society*. . . . New in the Washington area is **Bill Brody** who is a Clinical Associate with the National Heart Institute in Bethesda, Md. Bill is serving a two-year tour of duty with the Public Health Service. . . . Our final Washingtonian of the month is **Art Sindoris** who is working for the army's Harry Diamond Labs. Art and wife Lynne (Simmons '68) had a little girl, Rebecca Wendy, on November 1, 1973. The proud father participated in the delivery of his daughter and was there for on-the-spot photographs.

We also have a small contingent in the Boston area: **John Kassakian** has been an Assistant Professor in Electrical Engineering at M.I.T. since July 1973 . . . . **Jerry Robertson** is returning to M.I.T. to participate in the Sloan School's accelerated graduate program for the master's in Management. . . . **Ed Hoffer** has returned to the Boston area and is spending half-time applying computers in medicine and half-time practicing internal medicine at the Harvard Community Health Plan. The Hoffers' boat has turned into a down payment on a house in Wellesley. . . . **Bill Park** sent a note with news of his and other people's activities. Bill completed his Ph.D. thesis at the University of Pennsylvania with a thesis on "Control of a Multilegged Vehicle" in June of 1973. Bill had managed the timesharing system at the Moore School from September, 1972 to September, 1973 and then moved west to go backpacking. Bill is now at Stanford Research Institute as an observer working in robots. Bill reports that **Gordon Stallings** is taking wife Fran and daughter Rebecca to Japan on business for Reliance Electric. . . .

**Dave Cohn** writes that he has moved out of Dallas and back to the "real world" of South Bend, Indiana. Dave is teaching in the electrical engineering department at Notre Dame. . . . **Hank Lichstein** and wife Janine have a second son, Alexander Marc, born last December 16. The Lichsteins still live in New York City and spend their weekends in Hillsdale, N. Y. . . . **Kirby Meacham** is currently a staff engineer in the Design and Development Division of Booz-Allen Hamilton in Cleveland. Kirby has a wife and three-year-old boy, and spends his spare time scraping and painting houses. . . . **Gene Chase** is now Assistant Professor of Mathematics at Messiah College in Grantham, Penn. (That news from **Dennis Bekeny**).

**Edwin Kampmann** is teaching at California State College at Dominguez Hills in the Los Angeles area. Ed teaches urban and environmental management. . . . Lee Ann and **Richard Schwarz** report the birth of a son, Matthew Patton, on July 25 last year. . . . The **Richard Nathans** were expecting a baby as of March 15 (after they wrote). They already have a daughter, Wendy, about four years old. Richard is a principal chemist at Battelle's Columbus Laboratories where he heads the photochemistry group in the organic chemistry section. He works on solar energy and optical memories. . . . **Charles Rall** is working for A.T. and T. at headquarters in New York City on a two year loan from Bell Labs in New Jersey. Charles and Barbara adopted a baby boy, Joshua, in April 1973. They now have three boys, aged 1, 3 and 5, who keep them busy.

Back to Boston, there is a tenth reunion committee meeting Tuesday (the deadline for this column) at the **Matt Mlezivas**' in Acton. Details of the outcome next month.—**Steve Lipner**, Secretary, 3703 Stearns Hill Rd., Waltham, Mass. 02154

## 67

Well, I have finally departed graduate school and joined the ranks of the Establishment. In January I received my law degree and M.B.A. from Stanford University, and in February I passed the (expletive deleted) California Bar Exam. I am now working in Oakland with the law firm of Crosby, Heafey, Roach and May. On the consumption side, we recently purchased a home in Danville and are now trying to furnish it. Please visit us if you are in the area. . . . **Charles Marantz** received his M.B.A. from Harvard about a year ago. He writes that he is now happily employed as a financial analyst at Freeport Minerals Co. in Manhattan where he "loves that 'Big Apple' lifestyle—MMMM!". . . . **Ted Nygreen** is still at N.B.C. as Manager of Information Services Department. Although he received his graduate degrees from Princeton more than two years ago, Ted still lives in Princeton while working in New York City. "The swinging swirling world of Show Biz is

exciting—old friends should stop by in New York City.". . . After spending one year in Cincinnati at Avco Electronics, **Sheldon Bayer** decided to head south to Electronic Communications, Inc., and St. Petersburg, Fla., where he, his wife and two sons are enjoying the sunshine.

**Daniel Corwin** lives in Littleton, Mass., and is a computer scientist at Arcon Corp. . . . **Michael Henry** has been appointed Manager of the Oriented Superalloys Program at the General Electric Research and Development Center in Schenectady, N.Y. . . .**John Halberstadt** has transferred to Newark, N. J., and the Pigments Plant of DuPont. . . . Margie and **Richard Zinner** have a daughter, Michelle Lori, born September 22, 1973. They are living in Boston. . . . **John Rudy** has been appointed Manager of Operations Research for the manufacturing locations of Raytheon's Missile System Division. . . . After two years of graduate school at the University of Arizona, **Richard Boulay** has joined the Solar Division of International Harvester. . . . At last report Liz and **Larry Banks** were expecting their first child. They are doing well, as is their old English sheepdog, Wiffenpuff Bentley Bear. . . . **Henry Noble** was admitted to the Maryland Bar last December. . . . Dr. **John Smith** is a physician and has opened up a practice in Orange County, Calif. . . . **Alex Pitegoff** is now with Teradyne in downtown Boston.

**Bob Howard** wrote the following while staying in a hotel in Washington: "In case you're wondering, I'm only in Washington on business. I'm still working for the same company doing international construction financing. I'm here to help an African government client of ours coax $60 million of assistance from the U. S. government. Being based in Miami I have run into a number of our classmates. **Rich Bronowitz** has completed his Ph.D. in mathematics with a master's in I.E. and has been hired as an operations research analyst by the navy. . . . **Lou Offen** is a resident in neurology at Jackson Memorial Hospital in Miami. It turns out that he has been in Miami for two years but our paths never crossed. He also did medical work in Columbia and had some very interesting experiences. . . . **Eric Coe** is a cardiology fellow in Atlanta. He and his wife, Patti, recently purchased a house on a beautiful two-and-one-half acre wooded lot. They need the space to keep their growing menagerie of animals. . . . **Steve Alter**, who is presently pondering his Ph.D. thesis at Sloan, recently returned from a consulting assignment with the Norwegian shipowners association and hopes to go back again for the summer. . . . **Bob Shishko** passed through Miami on his way to give a paper in New York. He is still with Rand Corp., in Los Angeles. He recently returned from a gastronomic tour of Europe with a new sports car."

Vivien and **Theta Tsu** have returned to California to settle down after a year in Nairobi, Kenya, where they worked for the W.H.O. Cancer Research unit. They have purchased a small house in Palo Alto within biking distance of Stanford University and spend most of their weekends working in their vegetable gardens. They also study Chinese and teach their cockatiel to talk English. Theta works in the genetics department of the Stanford Medical Center. . . . We have two reports from **Jeff Schoenwald**. The first report states that Jeff was "hard at work on research for his impending Nobel Prize—superconducting chicken fat at room temperature." The second and later report is a disappointment: Jeff is on the way to becoming a "Scotch-swilling degenerate" in a swinging singles apartment complex in Dallas. He has also taken several pleasure trips in recent months. On the bright side, Jeff is paying his taxes and repaying his educational loans while working for the Central Research Laboratory at Texas Instruments.

At last report **John Toivonen** was finishing his thesis and moving towards fulfilling his fantasies. He writes that his life is becoming an unbelievable trip. . . . **Andrew Tanabe** is out of the air force and is living in North Grafton, Mass. He is an associate systems engineers at I.B.M. in Waltham, and his wife is a physical therapist for Handicapped Children's Services. . . . **John Reynolds** has been promoted to Supervising Engineer with the New York Telephone Co. . . . Linda and **Markus Zahn** happily report the birth of their third child, Jeffrey David. "Otherwise life in Florida is terrific." . . . After enduring a big storm and running aground in a chartered yacht, **John Ebert** is happy to be "still truckin" at McDonnell Douglas in St. Louis. . . . **Jerry Tomanek** received his M.B.A. from Stanford in 1973 and is now employed as a product manager in the I.C.O.R.E. division of Acurex Corp. . . . **Greg Zachrias** writes: "The air force has released my body. I am now back at our beloved alma mater deep in the land of cold feet, and the adjustment is not easy after Houston's heat and humidity. I'm currently putting the finishing touches on my master's thesis, but then, I was putting the finishing touches on the same thesis last July!". . . **John Patterson** is still in Puerto Rico, still married, and still in the navy, and he loves all three. He flies the A-4 Skyhawk whenever they get the fuel. . . .**Robert Trunek** spends many hours sailing his 26-foot Pearson Sloop. On weekdays he directs the engineering effort on $20 million of expansion at Arco's Houston refinery. Bob has an M.B.A. from the University of Houston, and Diane will soon receive a master's.

**Richard Stein** is doing electron spectroscopy at the National Bureau of Standards. "N.B.S. is almost *academe* and is more exciting than I would have thought. I am also continuing to bike, skate and ski to excess. All electrons are blue.". . . **Louis Schwartzkopf** is a post doctoral fellow in the Department of Physics at Rutgers. He also teaches a lab for first-year graduate students. . . . **Michael Scott** has graduated from U.C.L.A. Law School and is probably now being entertained by the California bar exam. He has joined Grossman, Smaltz, Graven and Perry. . . . **Robert Sitrin** has returned from the Woodward Research Institute in Basel, Switzerland, and is now working for Smith, Kline and French Laboratories in suburban Philadelphia. . . . **Ed Radlo** clerked for Associate Justice Thomas F. Kelleher of the Supreme Court of Rhode Island after graduating from Harvard Law School in 1972. Ed is now a patent attorney for Honeywell Information Systems, Inc., Waltham, Mass., and has thus returned to the field of computers. He is a member of the California, Rhode Island Patent Bars.

After 18 months with Xerox Corp., in Stamford, **Doug Benson** is an associate consultant with A. T. Kearney in New York. . . . **Don Bellinger** is General Manager for the Washington, D.C. district office of Call-A-Computer Time Sharing Service. He is looking for a farm to buy in West Virginia. . . . Joanie and **John Fittz** are in their fifth year at the University of Massachusetts with Campus Crusade For Christ. Their first child, Jonathan Edwards, arrived December 12. They will probably soon move to a metropolitan ministry. . . . **Richard Pikul** is now Chief Structural Engineer at Clough Associates in Albany, N.Y. . . . **Joel Berk** bought a home in Tenafly, N.J., and is now an instructor in management at Polytechnic Institute of N.Y. . . . **Michael Seltz** is a senior planner with Skidmore, Owings and Merrill in Washington, D.C. . . . **Robert Smylie** has been promoted to N.A.S.A. Washington Deputy of Technology. . . . **Gerald Siegel** has left Exxon to take a position as Supervisor of Technical Systems in the E.D.P. Department of Amerada-Hess in Woodbridge, N.J. He purchased a house in Montgomery Township, north of Princeton.

**Roy Gamse** is now director of the Economic Analysis Division of E.P.A. . . . **Ed Geltman** has finished his training in internal medicine at Bellevue Hospital in New York City and has joined the air force for two years. "God help me." . . . University of Texas Assistant Professor **Dave Schramm** has received the first Robert J. Trumpler Award from the Astronomical Society of the Pacific as "the year's most outstanding young astronomer." Dave received a $500 prize for his work in "nucleocosmochronology", which is the study of nuclear properties of certain elements to determine the ages of the elements and the universe. . . . **Howard Greenbaum** has been traveling around doing hardware monitoring for Bell Labs. He sees **Mike Crane** each time he is in San Francisco. . . . **John S. Reynolds**, in addition to teaching in the architecture department at the University of Oregon, was elected to a four-year term as one of five commissioners on the Eugene Water and Electric Board. He was also appointed to Oregon's Energy Advisory Committee, to recommend policy for the 1975 Oregon Legislature.—**Jim Swanson**, Secretary, 669 Glen Rd., Danville, Calif. 94526

## 71

Welcome to another chapter in the history of the Class of '71. We both passed our general exams (qualifiers) at the electrical engineering department at

Princeton University and are getting started on our Ph.D. theses, that is, right after we type up these Class Notes.

News of classmates still in school: **Michael W. Szeto** and **Donald H. Layton** have been awarded First-Year Honors at Harvard Business School and are now in the second year of Harvard's two-year M.B.A. program. . . . **Gordon E. Legge** writes, "Since receiving my B.S. in physics in '71, I have since received an M.A. in astronomy at Harvard, and am now pursuing a Ph.D. in experimental psychology at Harvard." . . . Since September 1972, **Donald Raila** has been a graduate student in the applied mathematics program at Princeton University. . . . **Tim Maloney** writes, "I've left the physics department here at Cornell with an M.S., and I'm spending the last year of my N.S.F. as a graduate student in electrical engineering." . . . **Gary Astrologes** is continuing work for a Ph.D. in organic chemistry at the University of Illinois. . . . **Clifton K. Chang** dropped us a note saying, "After graduating went to Harvard Business School. Taking a year off in New York City, worked as Financial Planning Analyst at First National City Bank. Now picking up M.B.A. at Harvard. The future? Hope to help develop the Asial Pacific." . . . **Timothy H. DeCook** told us "after spending the summer doing electron microscopy research, I am awaiting the beginning of my second year amidst the cornfields at the University of Iowa Medical School in Iowa City. In May 1973 I took the dive and married a Simmons graduate who is now working at the University Hospital School as a physical therapist." . . . **Hal Moorman** writes, "Entered S.M.U. Law School in Dallas. Decided to try a more hospitable climate for my (higher?) education." . . . **Zane Segal** will receive a Master of Fine Arts in cinema from the University of Southern California in June, 1974.

A news bulletin from the Washington University School of Medicine informed us that **Glenn A. Handler** has been elected as alternate member to Washington University School of Medicine's first student delegation to the Missouri State Medical Association. This is the first time students have been represented in the Association's delegate body. Glenn received his M.S. degree in 1972 from the University of Michigan, Ann Arbor. . . . **Steven I. Givot** writes, "**Barbara Sue Lamond**, '71) and I were married on September 11, 1971. I spent October, 1971, through August, 1972, at the University of Chicago Graduate School of Business; Barb worked as a methods engineer for Commonwealth Edison (their only female electric engineer). Then we moved to London, England, for a year to get M.S. degrees from the London School of Economics—the most overrated educational institution on the face of the earth. (Pass four exams—you only need 40 per cent to pass!—and in 12 months you get a master's degree!) Now we're back in Chicago—same school, same job. It's good to be back." . . .

News of classmates in the real(?) world: **Avi** "Blue Dragon Enterprises" **Ornstein** was in Princeton visiting and brought us up to date on himself and a few other classmates. Avi told us: "Bernice and I are now living in Somerville; married for a bit over one-half year now. My main source of income/occupation is as a teacher. I am currently teaching seventh grade biological science, eighth grade earth science, seventh grade math, and eighth grade math at the Blackstone-Milville Regional Junior-Senior High School. Blackstone is 50 miles from Somerville, however, so the commuting is a bit of a problem. Preparing for four different subjects also swallows up a lot of time, the earth science especially. I never have had a course beyond I.A.P., so I have to first teach myself.

"On the side I am continuing to produce posters for the M.I.T. community and remain semi-active in A.P.O., T.C.A., and L.S.C. **Bern Krafsig** has been stationed at an air force base outside of London. If any students who know him are going to Europe this summer, he and Sandy would welcome a visit. His address can be gotten from A.P.O. at M.I.T.

**Randolph G. Hawthorne** is still in Boston working in real estate financing. . . . **William P. Mammen** married Kay Morrison on December 21, 1973 and moved to Provo, Utah where Kay attends Brigham Young University.

That's all for this issue. Please send us news about yourself so we can keep the column long and active. . . . As for the Kent State Memorial Lectures (I hope you remember what happened at Kent State), we need a few more people for the supervising committee, especially, but not at all exclusively, people in the Boston area. If you are interested please write to us no later than September 1.—**Howard Jay Siegel** and **Leah Jamieson Siegel**, Class Officers, 228C Harrison St., Princeton, N.J. 08540

# 72

Hope you are all enjoying a good summer. By the time you read this I should be in Plymouth for a week with my Scout troop at summer camp, trying hard to make sure they don't do anything outrightly criminal. Now don't you feel relaxed in comparison?

I got a note from **Mark Mitchell**: "I'm on a nuclear, non-Polaris submarine. I joined the navy rather than be a private in the army. Since then I've been a lot of places—Newport for O.C.S., Supply School in Athens, Georgia, Nashville, Atlanta, Charleston, back north to New London for sub school, then to the Gulf Coast of Mississippi (a little hole called Pasagoula). Being on a sub sometimes reminds me of trying to fill a Baker "coffin" with 100 people, but it's a different way of life. Hopefully all we'll ever do is cruise around. Pray for peace."

**Marty Morris** is married and working for the Computer Corporation of America helping to open a San Francisco office for them. . . . Even further afield, **Brad Billetdeaux** wrote from Milnerton, South Africa, "After spending a year in the New York office of Caltex petroleum, I was transferred to an affiliates refinery in South Africa. Work in New York was totally different than here. New York is the head office and the job there was primarily concerned with keeping top management informed of what is happening elsewhere. Now I'm 'elsewhere.' I'm a process engineer and I'm finally getting down to some nitty-gritty engineering, putting pressure gages on heat exchangers and thermometers in thermal wells. Land sakes, I don't even use a computer anymore. In fact some of the engineering is so horseback that I don't even use a slide rule. But it's highly interesting. I have many more jobs than I can possibly handle, as the place is rather hectic. My main areas of responsibility are with the steam generation equipment and pollution abatement programs. The government here is well aware of the experiences of more developed countries in the environmental field, therefore they are not behind as far as pollution regulations go. My assignment here is tentatively scheduled to last two years, and we will be back in the States on leave in August.

"As of yet I see few birth announcements in your column. Therefore I submit this tidbit from our family. One six ounce strapping baby boy Siamese kitten, named Nasha, now dominates our household thoroughly. Some general impressions of South Africa are: nice climate, good beef and wine and an appalling political situation. The first two we're free and encouraged to enjoy. However as a foreigner it has been recommended to me to stay away from the third."—**Dick Fletcher**, 135 West St., Braintree, Mass 02184

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And here it is—the first Class of 1974 *Review* Column. Now we are alumni. I still remember arriving at M.I.T. as a freshman. Those four years went fast and we graduated (at least most of us graduated) and it is all over—except for those (including myself) who are continuing with graduate school. But whatever you are doing you cannot despair, for you will receive your *Technology Review*. All you have to do is turn to the 1974 Class Review and your worries will disappear.

Since this is the first time I have written this column, I do not have any news to report. Hopefully that will be changed for the next issue. Just send me a report of anything that is new with you. Do you have a new job? Are you getting engaged, married, divorced? Going overseas—send me a letter. I don't want to sound obnoxious, but . . . I will anyway.

Remember that this column is last in the Class Review section and the last column in *Technology Review*—an honor which we hold for a year. After that we are just another class review. If you write, then I won't have a chance to babble. Just take your pen or pencil (which has a point) and write a letter to me, about yourself or anyone else. Please do it now for I have to meet deadlines.—**Dennis Dickstein**, Secretary, 23 Howard St., Cambridge, Mass. 02139

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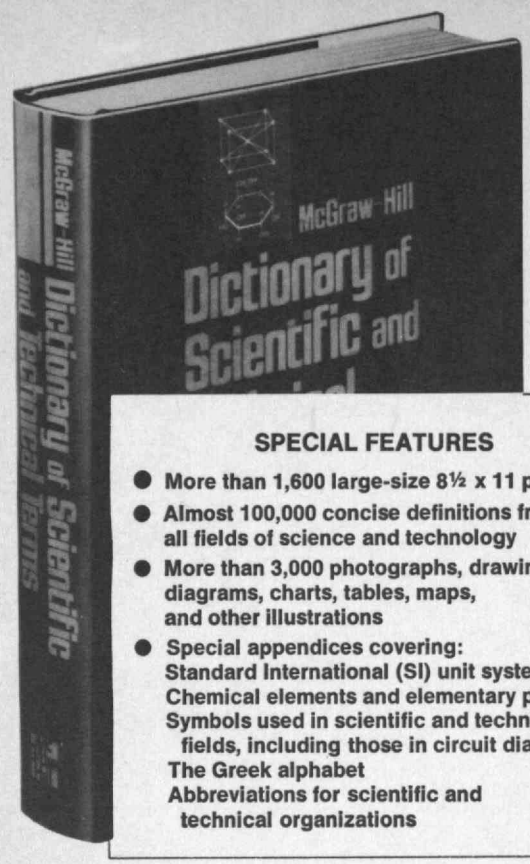


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